DEH2015. LWTS - 004220. E12

PDS 2014-MUP-95-007W1

Received
AUG 04
County of San Diego
Dept. of Environmental Health
Land & Water Quality Div.

Jayhawk Consultants

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May 25, 2015

Department of Environmental Health (DEH)
Attn: Scott Rosecrans, REHS
5500 Overland Ave., Suite 210
San Diego, Ca. 92123-1202
Telephone: (619) 208-0337
Electronic Mail: scott.rosecrans@sdcounty.ca.gov

Advanced Treatment System: 1191 Meadowlark Way, Ramona-[APN 280-041-22, 23 &24]

Dear Mr. Rosecrans:

This report was submitted to the Regional Board with a verbal concurrence of approval pending compliance with the California Environmental Quality Act (CEQA). Essentially, this became a regulatory conundrum because the State could not complete the approval process until the County completed the Major Use Permit (which remains in process).

Since the *Department of Environmental Health* (DEH) will be permitting "advanced treatment systems in the near term, this design is being submitted to the DEH which can complete the approval process with a stipulation of a forthcoming "Negative Declaration" from the *Planning Development Services* (PDS). This eliminates the conflict between a County Agency and the State. The "Form 600" and required Regional Board elements are also included in this submittal merely as information for DEH processing. However, the irrelevant portions can be discarded at the discretion of the DEH. This supplementary information includes correspondence previously addressed to the Regional Board and the individual elements of the design.

Installation constructs will be in accordance with the San Diego County *Department of Environmental Health* (DEH) Local Agency Management Program (LAMP) which include an installation inspection (pre and post) and a maintenance advisory manual for the applicant. Please do not hesitate to contact me with any questions at larry@septiclayout.com or by cellular at (760) 613-2185.

Sincerely,

L Newcomb

Larry Newcomb
REHS 3888
NEHA Certified Sanitarian

The design constructs were obtained by inserting variables into a computer application at www.geocom.com.

FIELD FLOW

Job Description:	*Mountain View Community Church*
Contact:	*Jayhawk Consultants aka Larry Newcomb; Phone: (760) 613-2185*
Prepared by:	*sameas contact*
Date:	*)8/10/2014*

Worksheet 1- Field Flow

Total field

Total Quantity of effluent to be disposed per day	2,500	gallons / day
Hydraulic loading rate	0.7	gallons / sq.ft. / day
Minimum Dispersal Field Area	3,571	square ft.
Total Dispersal Field Area	3,571	square ft.

Flow per zone

Number of Zones	3	zone(s)
Dispersal area per zone	1,190	square ft.
Choose line spacing between WASTEFLOW lines	2	ft.
Choose emitter spacing between WASTEFLOW emit	2	ft.
Total linear ft per zone (minimum required)	595	ft. per zone
Total number of emitters per zone	298	emitters per zone
Select Wasteflow dripline (16mm)	Wasteflow PC - 1/2gph	dripline
Pressure at the beginning of the dripfield	20	psi
Feet of Head at the beginning of the dripfield	46.2	ft.
What is the flow rate per emitter in gph?	0.53	gph
Dose flow per zone	**2.63**	**gpm**

Note: A few States or Counties require additional flow for flushing. Please check your local regulation.
Flush velocity calculation below is for PC dripline. Classic dripline requires less flow to flush than PC.
Please refer to Geoflow's spreadsheet "Design Flow and Flush Curves" at www.geoflow.com or call 80

If required, choose flush velocity	0.5	ft/sec
How many lines of WASTEFLOW per zone?	4	lines
Fill in the *actual* length of longest dripline lateral	149	ft.
Flush flow required at the end of each dripline	0.37	gpm
Total Flow required to achieve flushing velocity	1.48	gpm
Total Flow per zone- worst case scenario	**4.11**	**gpm**

Select Filters and zone valves

Select Filter Type	BioDisc Self Flushing Battery	
Recommended Filter (item no.)	BioDisc Battery 2	40-70 gpm / 40 psi
Select Zone Valve Type	Electric Solenoid	-
Recommended Zone Valve (item no.)	SVLVB-100	1-in. Solenoid valve

Dosing

Number of doses per day / zone:	12	doses
Timer ON. Pump run time per dose/zone:	26.25	mins:secs
Timer OFF. Pump off time between doses	1:33	hrs:mins
Per Zone - Pump run time per day/zone:	5:16	hrs:mins
All Zones - Number of doses per day / all zones	36	doses / day

GEOFLOW SUBSURFACE DRIP — **Pump Size**

Job Description:	
Contact:	
Prepared by:	same
Date:	

Pressure losses may be grossly overstated, particularly if designing with WASTEFLOW Classic
The letters on the diagram(right) match the letters in section 2 below.

Worksheet - Pump Sizing

Section 1 - Summary from Worksheet 1	
Flow required to dose field	2.48 gpm
Flow required to flush field	2.96 gpm
Flow required to dose & flush field	5.44 gpm
Filter	BioDisc-150
No. of Zones	4 zones
Zone valve	SVLVB-100
Dripline	Wasteflow PC - 1/2gph
Dripline longest lateral	71.00 ft.

Section 2	Ft of head	Pressure
A. Flush line - **Losses through return line**		
Size of flush line in inches	1 inch	
Length of return line	316 ft.	
Equivalent length of fittings	79 ft.	
Elevation change. (if downhill enter 0)	33 ft.	
Pressure loss in 100 ft of pipe	0.83 ft.	0.36 psi
Total pressure loss from end of dripline to return tank	*36.3 ft.*	15.71 psi
B. Dripline - **Losses through Wasteflow dripline**		
Length of longest dripline lateral	71 ft.	
Minimum dosing pressure required at end of dripline	23.10 ft.	10.00 psi
Loss through dripline during flushing	2.59 ft.	1.12 psi
Total minimum required dripline pressure	*25.69 ft.*	1.12 psi
A+B. Minimum Pressure required at beginning of dripfield		
CALCULATED pressure required at beginning of dripfield	*61.98 ft.*	26.83 psi
SPECIFIED pressure at beginning of dripfield (from workshst 1)	69.3 ft.	30.00 *psi*
Great! SPECIFIED Pressure is greater than CALCULATED Pressure requirement. Go to next step		
C. Drip components - **Losses through headworks**		
Filter	4.6 ft.	2.00 psi
Zone valve pressure loss (not in diagram)	0.69 ft.	0.30 psi
Flow meter pressure loss (not in diagram)	ft.	- psi
Other pressure losses	ft.	- psi
Total loss through drip components	5.31 ft.	2.30 psi
D. Supply line - **Minimum Pressure head required to get from pump tank to top of dripfield**		
Size of supply line in inches	1 inch	
Length of supply line	1.25 ft.	
Equivalent length of fittings	54 ft.	
Height from pump to tank outlet	5 ft.	
Elevation change. (if downhill enter 0)	0 ft.	
Pressure loss/gain in 100 ft. of pipe	2.58 ft.	1.12 psi
Total gain or loss from pump to field	*6.4 ft.*	2.78 psi
Total dynamic head	81.0 ft.	35.08 *psi*
Pump capacity *	5.4 gpm	
Pump Model Number		
Voltz / Hp / phase		

* Note: Pump capacity flow assumes flow in dripline does not change during a dose cycle. With Wasteflo
For more accurate flows please see Geoflow's **Flushing worksheet.**

If you need assistance designing for this additional flow, please

a. See Geoflow flushing worksheet or

b. Contact Geoflow at 800-828-3388.

Appendum to "Attachment "A"
Nine (9) Pages

GEOFLOW SUBSURFACE DRIP

SUBSURFACE DRIP SYSTEMSAS APPLIED TO ONSITE EFFLUENT DISPOSAL OF WASTEWATER IN CALIFORNIA

by Rodney Ruskin, Geoflow, Inc.
David Dauwalder, Dauwalder Engineering, Inc.,
Steven Braband, Biosolutions, Inc.

Introduction Subsurface drip disposal (SSDD) of effluent was first used in Hawaii, Georgia and Texas. As summer rainfall areas, these soils in general are very different from those in California. In Georgia and Texas most applications are in very heavy clay soils where conventional drainfields would not function. However, conditions in California are sufficiently different to warrant discussion.

In California, either deliberately or accidentally, all drainfields contribute to vegetative growth. Effluent disposal and irrigation are hydraulically similar but the design requirements are not identical. With effluent disposal, the aim is to dispose of the product within a minimum area, as quickly and safely as possible, and at an approximately uniform rate throughout the year. A disposal system must operate in the rain, while an irrigation system does not. With irrigation, the aim is to optimize the use of water over as large an area as possible, with an allowance made for a wide range of water usage between seasons.

The advantages of using SSDD for effluent disposal are many.

- Health risks are minimized.
- Pollution of storm water runoff is minimized.
- It can be used under difficult circumstances of high water tables, tight soils, steep slopes or wind,
- Disposal of water by means of evapotranspiration by the plants is maximized.
- Opportunities to re-use the cleaned water are increased.
- Deep percolation is minimized.
- Consumption of nitrates by the plant material is increased.
- Has invisible and vandal-proof installations,
- The systems are durable and have a long life expendency.
- It is non-intrusive and allows use of the space while irrigating.
- The system is easily automated.

Principles of SSDD

A single pulse of water is applied subsurface, which moves out by capillary action, laterally and vertically as well as downwards. The wetted volume for subsurface (on the left) is 40% larger than the wetted area for surface (on the right). The same amount of water was applied; hence, there is more air in the pores with subsurface compared to surface. If the biological loading rate is less than the ability of the soil to absorb the pathogens, there will never be a buildup of a biological mat around the emitter, and the system will operate indefinitely. If the instantaneous application rate is low enough never to saturate the soil, the capillary movement will be more important than gravity. Of course, the total application must be less than the ability of the soil to percolate downwards through the underlying layers in the soil. If one applies the effluent in short pulses with adequate rest periods in between pulses, one can view each emitter as a single sewage treatment plant.

Pretreatment

Most SSDD is used with effluent treated to a minimum standard of BOD/TSS < 20 mg/l. Disinfection with chlorine is not encouraged because it kills the useful soil bacteria and may damage roots. U.V. disinfection does not present this problem; however, U.V. disinfection is not usually required. The bactericide lined dripline does not require chlorine to prevent slime buildup in the tubing.

SSDD with filtered septic effluent taken directly from a septic tank is permitted in several states. With special precautions this does work well. Because this is not a common practice in California, this article will not cover that technique.

System Components

A typical drip system installation consists of the following elements.

- **Vacuum relief valves**

  Vacuum breakers installed at the high points protect the system from sucking dirt back into the drip line. Due to back-siphoning or back-pressure, this is an absolute necessity with underground drip systems.

- **Pressure regulator**

  Under normal operating conditions, pressure in the drip lines should be between 10 and 45 psi for pressure compensating emitters and between 15 and 25 psi for non-compensating emitters. The need for a pressure regulator will depend upon pump characteristics.

- **Filters**

  A filter is absolutely required. A 150 mesh (100 micron) filter is suitable.

- **Controllers**

  A programmable logic controller (PLC) is recommended for large systems or for any system with a BOD > 20 mg/l. This can be linked by modem to the engineer in charge in order to continuously monitor the system.

- **Electric solenoid valves**

  These valves control the automatic flushing of the filter and field, and can also be used to segregate multiple zones on larger systems. Manual operation can be used, instead of automation, on small systems with high quality effluent.

- **Emitter lines**

  There are two types of emitters.

  Non-compensating (often called classic or turbulent flow) emitters operate best at between 15 and 25 psi. Commercially available for SSDD with a 1.3 gph flow rate, they use a very well proven technology with over 20 years experience. They have no moving parts and are lower in cost than pressure compensating emitters.

  Pressure compensating emitters give the same flow from 10 – 60 psi. They are available in 1 gph flow rates. They are valuable for working on slopes, long lateral runs and the designed gph flow rate is suitable for very heavy or very sandy soils.

  Root intrusion into a buried emitter is a risk. There are two techniques offered on the market which are guaranteed to inhibit root intrusion. One company offers a herbicide impregnated emitter (ROOTGUARD®) with a 15– year guarantee against root intrusion.

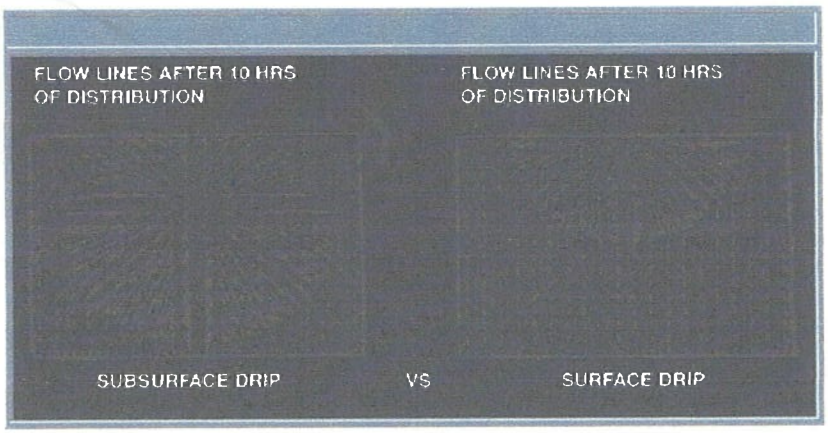
Another company offers a filter (Techfilter®) which slowly releases a vegetation control chemical (trifluralin) through each emitter which inhibits root intrusion into the system. A replaceable Techfilter Cartridge allows renewal of protection for a life-time extended warrantee.

Bacterial slime can grow in the polyethylene emitter lines. Tubing lined with a bactericide is available. Alternatively, a vigorous scour rate of 2 ft/sec is recommended.

- **Flushing manifold**

  In order to help clean the system, the ends of the drip lines are connected together into a common flushing line. This line will help equalize pressures in the system. Periodic flushing will guarantee a long system life. It should be done frequently during the installation and start up period. To control any health hazard, this flush water should return to the treatment plant.

Figure 1



SYSTEM DESIGN

Design parameters for a typical drip system are as follows.

Area Selection

Select the area with careful consideration of the soil and the terrain Be sure the field is not in a flood plain or bottom of a slope where excessive water may collect after rain.

Soil Application Design

The instantaneous water application rate of the system must not exceed the water absorption capacity of the soil. A determination of the instantaneous water absorption capacity of the soil is difficult, however, since the value varies with the water content of the soil. As the soil approaches saturation with water, the absorption rate reduces to an equilibrium rate called the "saturated hydraulic conductivity." Wastewater application rates should be less than 10 percent of this saturated equilibrium.

Table 1

Soil Class	Soil Type	Soil Absorption Rates: Est. Soil Perc. Rate minutes/in	Soil Absorption Rates: Hydraulic Conductivity inches/hr	Design Hydraulic Loading Rate gal / sq. ft. per day	Total Area Required sq. ft./ 100 gallons per day
I	Coarse - sand	<5	>2	1.400	71.5
I	Fine sand	5-10	1.5-2	1.200	83.3
II	Sandy loam	10-20	1.0-1.5	1.000	100.0
II	loam	20-30	0.75-1.0	0.700	143.0
III	Clay loam	30-45	0.5-0.75	0.600	200.0
III	Silt-clay loam	45-60	0.3-0.5	0.400	250.0
IV	Clay non-swell	60-90	0.2-0.3	0.200	500.0
IV	Clay - swell	90-120	0.1-0.2	0.100	800.0
IV	Poor clay	>120	<0.1	0.075	1333.0

Table 1 For guidance only
Consult with the RWQCB and/or County Health Department

Table 1 shows the recommended hydraulic loading rates for various soil conditions. These loading rates assume a treated effluent with BOD and TSS values of less than 30 mg/l is produced in the pre-treatment system.

Depth and Spacing

Systems usually have emitter lines placed on 2 foot (600 mm) centers with a 2 foot emitter spacing such that each emitter supplies a 4 sq. ft (0.36 m2) area. These lines are best placed at depths of 6-10 inches (150 - 250 mm) below the surface. This is a typical design for systems on sandy and loamy soils with a cover crop of lawn grass. Closer line and/or emitter spacing of 12 inches may be used on heavy clay soils or very coarse sands where lateral movement of water is restricted. Using closer spacing should not reduce the size of the field.

Soil layers and types

The shallow depth of installation is an advantage of the subsurface dripfield since the topsoil or surface soil is generally the most biologically active and permeable soil for accepting water. The topsoil also dries the fastest after a rainfall event and will maintain the highest water absorption rate. The quality and homogeneity of the soil may present a problem. If the soil was not properly prepared and there are pieces of construction debris, rocks and non-uniform soils, it is very difficult to obtain uniform water spread. In all cases, but particularly if the soil is compacted, soil properties can be greatly improved by ripping and disking.

Adding Soil Fill

Some disposal sites require additional soil be brought in for agronomic reasons or to increase separation distances from the restrictive layer. Placing drip lines in selected fill material above the natural soil provides an aerated zone for treatment. Disposal however still occurs in the natural soil and the field size must be based on the hydraulic capability of the natural soil to prevent hydraulic overload.

Any time fill material is to be used, the area to receive the fill should have all organic material removed or it must be incorporated into the natural soil to prevent an organic layer from forming and restricting downward water movement.

The fill material should be applied in shallow layers with the first 4 to 6 inches incorporated into the natural soil to prevent an abrupt textural interface. Continue this process until all fill has been incorporated.

The fill area should be left crowned to shed surface water and may need diversion ditches or some other devices to prevent surface water from infiltrating. The entire fill area should have a vegetative cover to prevent erosion. If possible allow the fill to set at least seven to ten days before installing.

HIGH POINTS, SIPHONING AND SLOPES

A potential problem with buried drip lines is siphoning dirt into the emitters when the pump is switched off. Drip lines should either have a fairly constant slope, or where practical run driplines along a contour.

At least one vacuum breaker should be installed at the highest point in each zone.

Avoid installing lines on rolling hills where you have high and low points along the same line. If this is unavoidable, connect the high points together and install a vacuum breaker on the connecting line. Driplines should be connected to a common return line with a flush valve.

Excessive Level Differences

If the level variation within a zone exceeds six feet, individual pressure regulators should be placed for each six-foot interval or a pressure compensating emitter should be used.

At the end of each dosing cycle water, in the dripline will flow down to the bottom lines within the drip zone. This is called "lowhead drainage". On a slope site install small manifolds with a maximum of 1500 ft of dripline within each zone or sub-zone to offset lowhead drainage.

Slopes

Concentrate drip lines at the top of the hill with wider spacing towards the bottom. In the case of compound slopes consult a professional irrigation designer or engineer.

Reuse for Irrigation

In addition to the water saving aspect of re-use, a good vegetative cover is an advantage to prevent erosion from the field and consume both water and nitrogen applied to the rooting zone. Sites should be planted or seeded immediately after installation. Grasses are particularly suitable for this application. Most lawn grasses will use 0.25" to 0.35" (6.3 - 8.9 mm) of water per day during the peak-growing season. This calculates to be about 0.16 to 0.22 gal/ft2/day, a significant part of the daily effluent loading. By over-seeding lawns with winter ryegrass, this use efficiency can be continued through much of the year.

For vegetation using 0.16 to 0.22 gal/ft2/day by evapotranspiration, a sewage flow of 1000 gallons per day would supply the water needs of a landscaped area of 4600 to 6400 sq. ft. without having to add fresh water. For areas larger than this, the plants will suffer water stress during the hot months unless additional fresh water is applied. While California has been one of the last states to adopt SSDD of effluent, for over 25 years it has been the pioneer in using subsurface drip irrigation systems in both agriculture and landscaping. This slow adoption of SSDD could be connected with the regulatory structure.

Figure 2

Chart 1 – Dripline

Dripline Tables

Refer to Geoflow's Flow and Flushing Worksheet for further hydraulic details

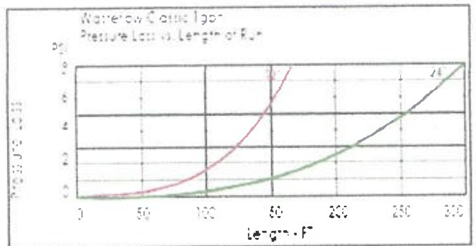
Wasteflow Classic

Flow Rate vs. Pressure

Pressure		Dripline	
psi	ft.	WF16-4-24	WF16-4-12
10 psi	23.10 ft	[illegible]	[illegible]
15 psi	34.65 ft	1.13 gph	1.13 gph
20 psi	46.20 ft	1.30 gph	1.30 gph
25 psi	57.75 ft	1.47 gph	1.47 gph
30 psi	69.30 ft	1.62 gph	1.62 gph
35 psi	80.85 ft	1.76 gph	1.76 gph
40 psi	92.40 ft		
45 psi	103.95 ft	1.89 gph	1.89 gph

Maximum Length of Run vs. Pressure

Pressure		Emitter Spacing		
psi	ft.	24"	18"	12"
10 psi	23.10 ft	170	165	100
15 psi	34.65 ft	170	165	100
20 psi	46.20 ft	170	165	100
25 psi	57.75 ft	170	165	100
30 psi	69.30 ft	170	165	100
35 psi	80.85 ft	170	165	100
40 psi	92.40 ft	170	165	100
45 psi	103.95 ft	170	165	100



Note, when using this length to look up pressure losses in the dripline, only the flow going out of the emitters is used and does not reflect true pressure loss during flushing. Pressure loss during flushing is self calculated in the cell below, or can be obtained from Geoflow's Flushing spreadsheet.

Wasteflow PC 1/2 gph

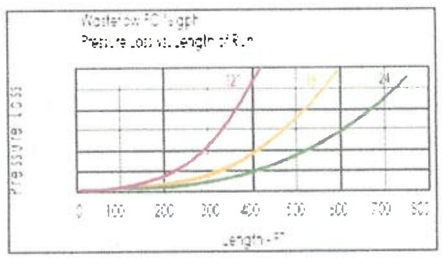
Flow Rate vs. Pressure

Pressure	Head	Dripline	
		WFPC16-2-24	WFPC16-2-12
7-60 psi	16 - 139 ft	0.53 gph	0.53 gph

Maximum Length of Run vs. Pressure

Pressure		Emitter Spacing			
psi	ft.	6"	12"	18"	24"
10 psi	23.10 ft				
15 psi	34.65 ft		174	260	322
20 psi	46.20 ft	120	225	330	424
25 psi	57.75 ft		255	377	474
30 psi	69.30 ft	160	284	415	535
35 psi	80.85 ft		313	448	576
40 psi	92.40 ft	172	330	478	612
45 psi	103.95 ft		354	501	651
[illegible]	[illegible]		383	523	679
[illegible]	[illegible]		377	544	700
[illegible]	[illegible]		403	563	727

Not recommended with pressures greater than 45 psi



Note, when using this length to look up pressure losses in the dripline, only the flow going out of the emitters is used and does not reflect true pressure loss during flushing. Pressure loss during flushing is self calculated in the cell below, or can be obtained from Geoflow's Flushing spreadsheet.

Wasteflow PC 1 gph

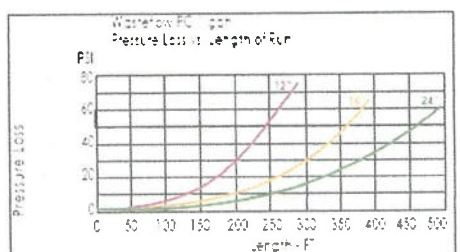
Flow Rate vs. Pressure

Pressure	Head	Dripline	
		WFPC16-4-24	WFPC16-4-12
7-60 psi	16 - 139 ft	1.02 gph	1.02 gph

Maximum Length of Run vs. Pressure

Pressure		Emitter Spacing			
psi	ft.	6"	12"	18"	24"
10 psi	23.10 ft	50	91	140	175
15 psi	34.65 ft	63	115	172	211
20 psi	46.20 ft	74	146	210	260
25 psi	57.75 ft	88	171	243	314
30 psi	69.30 ft	94	180	266	335
35 psi	80.85 ft	103	199	287	379
40 psi	92.40 ft	110	211	301	388
45 psi	103.95 ft	116	222	321	429
[illegible]	[illegible]		323	334	431
[illegible]	[illegible]		340	347	445
[illegible]	[illegible]		349	360	466

Not recommended with pressures greater than 45 psi



Note, when using this length to look up pressure losses in the dripline, only the flow going out of the emitters is used and does not reflect true pressure loss during flushing. Pressure loss during flushing is self calculated in the cell below, or can be obtained from Geoflow's Flushing spreadsheet.

Wasteflow PC 0.75 gph

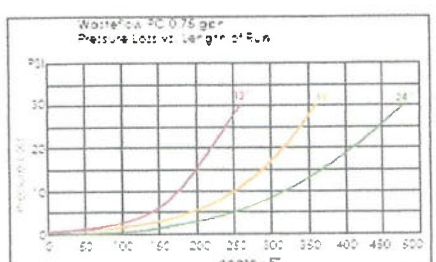
Flow Rate vs. Pressure

Pressure	Head	Dripline	
		WFPC16-6-24	WFPC16-6-12
7-60 psi	16 - 139 ft	0.71 gph	0.71 gph

Maximum Length of Run vs. Pressure

Pressure		Emitter Spacing			
psi	ft.		12"	18"	24"
10 psi	23.10 ft				
15 psi	34.65 ft		140	200	247
20 psi	46.20 ft				
25 psi	57.75 ft		203	299	383
30 psi	69.30 ft				
35 psi	80.85 ft		251	350	462
40 psi	92.40 ft				
45 psi	103.95 ft		284	407	522
[illegible]	[illegible]				
[illegible]	[illegible]				
[illegible]	[illegible]				

Not recommended with pressures greater than 45 psi



Note, when using this length to look up pressure losses in the dripline, only the flow going out of the emitters is used and does not reflect true pressure loss during flushing. Pressure loss during flushing is self calculated in the cell below, or can be obtained from Geoflow's Flushing spreadsheet.

Chart 2 – PVC Pressure Loss Charts

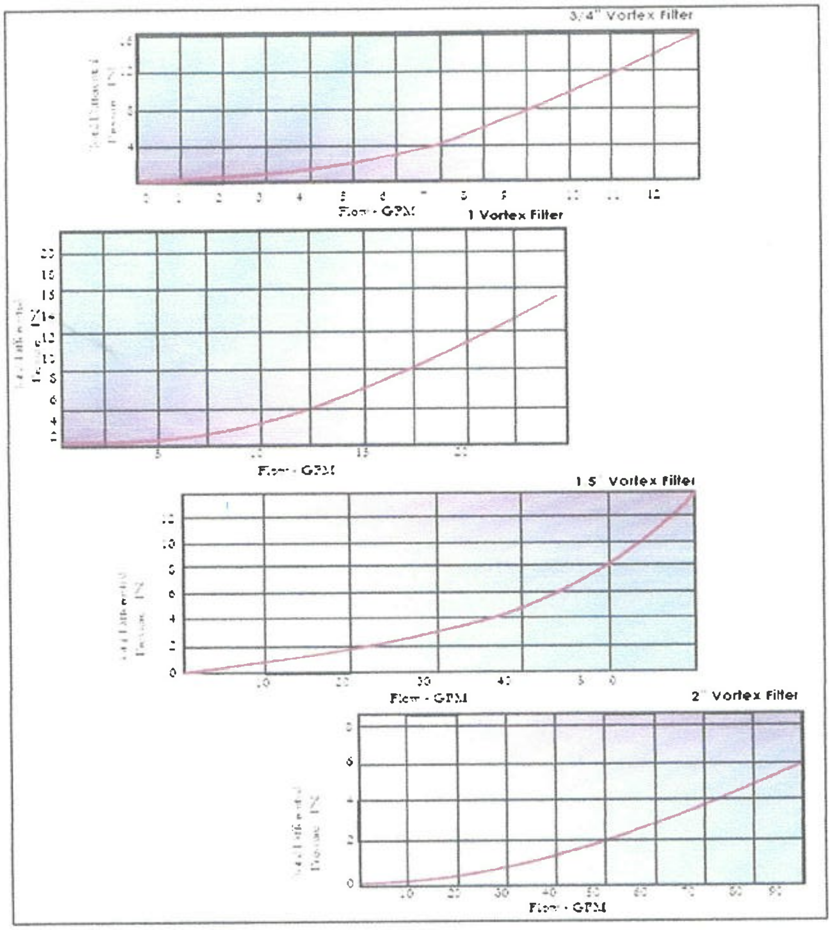
PVC 40 FRICTION LOSS CHART

	½" pipe		¾" pipe		1" pipe		1 ¼" pipe		1 ½" pipe	
	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI
1	1.05	0.43	0.60	0.11	0.37	0.03				
2	2.11	1.55	1.2	0.39	0.74	0.12	0.43	0.03		
3	3.17	3.27	1.8	0.83	1.11	0.26	0.64	0.07	0.47	0.03
4	4.22	5.57	2.41	1.42	1.48	0.44	0.86	0.11	0.63	0.05
5	5.28	8.42	3.01	2.15	1.86	0.66	1.07	0.17	0.79	0.08
6	6.33	11.81	3.61	3.01	2.23	0.93	1.29	0.24	0.95	0.11
8	8.44	20.10	4.81	5.12	2.97	1.58	1.72	0.42	1.26	0.20
10	10.55	30.37	6.02	7.73	3.71	2.39	2.15	0.63	1.58	0.30
15			9.02	16.37	5.57	5.06	3.22	1.33	2.36	0.63
20					7.42	8.61	4.29	2.27	3.15	1.07
25					9.28	13.01	5.36	3.42	3.94	1.63
30					11.14	18.22	6.43	4.80	4.73	2.27
35							7.51	6.38	5.52	3.01
40							8.58	8.17	6.30	3.88
45							9.65	10.16	7.09	4.80
50							10.72	12.35	7.88	5.83
60									9.46	8.17
70									11.03	10.87

	2" pipe		2 ½" pipe		3" pipe		4" pipe		6" pipe	
	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI	Velocity FPS	Pressure Drop PSI
6	0.57	0.03								
8	0.76	0.06	0.54	0.02						
10	0.96	0.09	0.67	0.04						
15	1.43	0.19	1.01	0.08	0.65	0.03				
20	1.91	0.32	1.34	0.13	0.87	0.05				
25	2.39	0.48	1.67	0.20	1.08	0.07				
30	2.57	0.67	2.01	0.28	1.30	0.10				
35	3.35	0.89	2.35	0.38	1.52	0.13	0.88	0.03		
40	3.82	1.14	2.64	0.48	1.73	0.17	1.01	0.04		
45	4.30	1.42	3.01	0.60	1.95	0.21	1.13	0.05		
50	4.78	1.73	3.35	0.73	2.17	0.25	1.26	0.07		
60	5.74	2.42	4.02	1.02	2.60	0.35	1.51	0.09		
70	6.69	3.22	4.69	1.36	3.04	0.47	1.76	0.12		
80	7.65	4.13	5.36	1.74	3.47	0.60	2.02	0.16		
90	8.60	5.13	6.03	2.16	3.91	0.75	2.27	0.20		
100	9.56	6.23	6.70	2.63	4.34	0.91	2.52	0.24	1.11	0.03
125	11.95	9.42	8.38	3.97	5.42	1.38	3.15	0.37	1.39	0.05
150			10.05	5.56	6.51	1.93	3.78	0.51	1.67	0.07
175					7.59	2.57	4.41	0.68	1.94	0.09
200					8.68	3.40	5.04	0.90	2.22	0.12

Chart 3 – Filters

Vortex Filters



BioDisc Filters

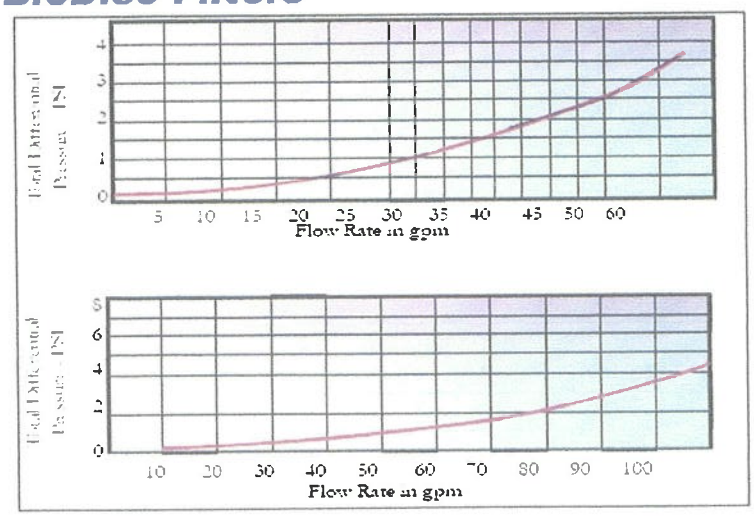
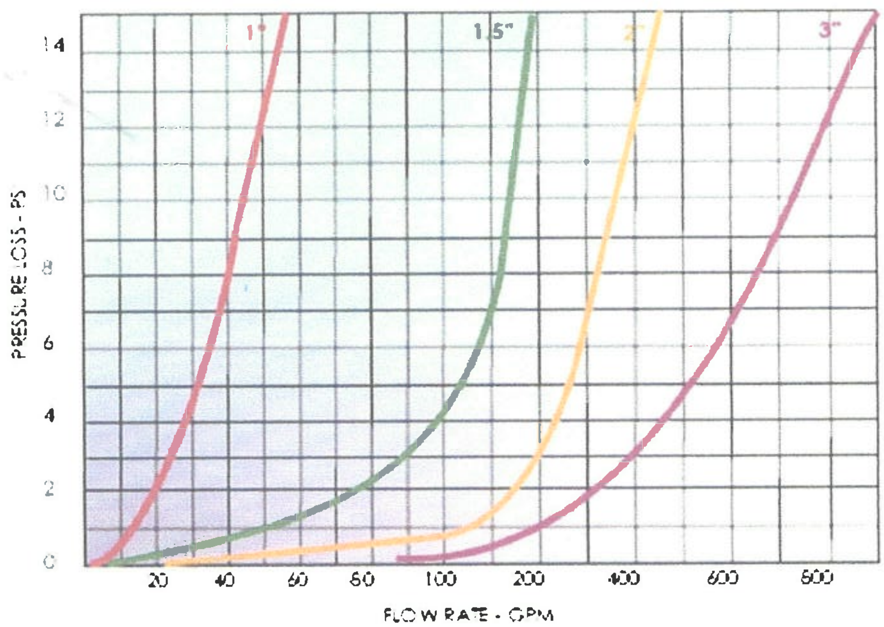


Chart 4 - Valves

Solenoid valves

Part Numbers	Size
SVLVB-100	1"
SVLVB-150	1.5"
SVLVB-200	2"
SVLVB-300	3"

Flow vs Pressure



Hydraulic Valves

Flow vs. Pressure

		Flow			
Part No.	No. of Zones	10 gpm		20 gpm	
		psi	ft	psi	ft
4402	2 zone	2	4.62	3	6.93
4403	3 zone	2	4.62	3	6.93
4404	4 zone	2	4.62	3	6.93
4405	5 zone	2.5	5.8	4.5	10.4
4406	6 zone	2.5	5.8	4.5	10.4

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July 2, 2014

San Diego Regional Water Quality Control Board (9)
Attn: Robert W. Morris, P.E.
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Telephone: (858) 467-2952
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***Mountain View Community Church* – Wastewater Disposal (Advanced Treatment)**

Dear Mr. Morris:

This letter is a discussion of chemistry and microbiology related to expected effluent characteristics from a proposed "Advanced Treatment System" for the Mountain View Community Church in Ramona. It is intended to supplement elements for a "Report of Waste Discharge" (ROWD). The project is summarized as a non-conventional onsite disposal system to allow future expansion of church population.

It is concluded the subsurface disposal of the discharge of the wastewater from the headworks will not cause the concentration of constituents beneath or down gradient of the site to exceed applicable groundwater qualities as established in Table 3-3 of the Basin Plan (Santa Maria Hydrologic Sub Area Basin) nor will the discharge be higher than the primary and secondary maximum concentration levels as established in Title 22 of the California Code of Regulations (CCFR) and referenced in the Basin Plan.

The basis for this declaration is as follows:

1. The Regional Water Quality Control Board (RWQCB) recognizes the limited impact from domestic waste subsurface discharge by granting "General" and "Specific" Waiver Conditions.

2. Technical literature abounds with findings which argue the removal of both organic and inorganic chemical compounds by absorption, neutralization and microbiological degradation within the "A" Horizon of the soil. Exceptions are noted for the very soluble disassociated ion NO_3^- and this is addressed as follows:

   This project should not contribute to excessive nitrate because dilution can be expected to effectively neutralize the threat. The nominal 2.5 acres combined with offsite open space and road area exceeds four acres and the average annual precipitation is on the order of 15" to 18". The premise being the usual model for nitrate mass balance such as the one espoused by Dr. David Huntley and popularized by the RWQCB.

3. Total dissolved solids TDS) is also negated because the AdvanTex ®" AX20 Mode 1B advanced treatment system has been certified by the *National Sanitation Foundation* (NSF) for meeting the strict parameters of ANSI/NSF Standard 40.

4. Although the reason for this proposed "advanced treatment" is related to shallow soil on the order of five feet in some areas of the project site, the inference from the technical literature supports the argument for a negative declaration of impact on the local groundwater basin. Moreover, the proposed advanced treatment results in a better effluent quality paradigm than a conventional septic leach field.

   A *contra* argument could be made for refuting this inference if the soil depth of five feet was not acceptable for treatment. However, there is a plethora of professional papers which argue acceptable treatment within the five foot depth. Notable studies have been done by academia at the University of Wisconsin and others such as comparison of conventional septic tank discharge and soil treatment by Dr. Timothy Winneberger at the University of Arizona and also the often referenced studies by R.L. Siegrist, D.L. Anderson and J.C. Converse.

Contemporary discussion of both conventional and advanced treatment include the current *US Environmental Protection Agency Onsite Treatment Systems Manual Manual* (Chapters 3 and 4) and the classical writings of Cantor and Knox for mathematical proofs and models. Another good resource for these type of issues are opinions expressed by Dr. O. Benjamin Kaplan in the second edition of his *Septic Systems Handbook*; especially Chapter 11 (Degradation of Groundwater by Septic Systems) and Chapter 12 (Nitrate in Groundwater).

These reference sources can be provided for your assessment if requested. As a general summary of the issue, an excerpt from the *US Environmental Protection Agency Onsite Treatment Systems Manual* (Chapter 3) follows:

> **3.7 Transport and fate of wastewater pollutants in the receiving environment**
>
> Nitrate, phosphorus, pathogens, and other contaminants are present in significant concentrations in most wastewaters treated by onsite systems. Although most can be removed to acceptable levels under optimal system operational and performance conditions, some may remain in the effluent exiting the system. After treatment and percolation of the wastewater through the infiltrative surface biomat and passage through the first few inches of soil, the wastewater plume begins to migrate downward until nearly saturated conditions exist. The worst case scenario occurs when the plume is mixing with an elevated water table. At that point, the wastewater plume will move in response to the prevailing hydraulic gradient, which might be lateral, vertical, or even a short distance upslope if ground water mounding occurs (figure 3-8). Moisture potential, soil conductivity, and other soil and geological characteristics determine the direction of flow.
>
> Further treatment occurs as the plume passes through the soil. The degree of this additional treatment depends on a host of factors (e.g., residence time, soil mineralogy, particle sizes).

3.7.1 Wastewater pollutants of concern

Environmental protection and public health agencies are becoming increasingly concerned about ground water and surface water contamination from wastewater pollutants. Toxic compounds, excessive nutrients, and pathogenic agents are among the potential impacts on the environment from onsite wastewater systems. Domestic wastewater contains several pollutants that could cause significant human health or environmental risks if not treated effectively before being released to the receiving environment.

A conventional OWTS (septic tank and SWIS) is capable of nearly complete removal of suspended solids, biodegradable organic compounds, and fecal coliforms if properly designed, sited, installed, operated, and maintained (USEPA, 1980a, 1997). These wastewater constituents can become pollutants in ground water or surface waters if treatment is incomplete. Research and monitoring studies have demonstrated removals of these typically found constituents to acceptable levels. More recently, however, other pollutants present in wastewater are raising concerns, including nutrients (e.g., nitrogen and phosphorus), pathogenic parasites (e.g., Cryptosporidium parvum, Giardia lamblia), bacteria and viruses, toxic organic compounds, and metals. Their potential impacts on ground water and surface water resources are summarized in table 3-16. Recently, concerns have been raised over the movement and fate of a variety of endocrine disrupters, usually from use of pharmaceuticals by residents. No data have been developed to confirm a risk at this time.

It is concluded the use of an advanced treatment system for disposal of onsite wastewater would not be a hazardous waste as defined in the California Health and safety Code, § 25140 *to wit*:

> **25140**. The department shall prepare, adopt and may revise when appropriate, a listing of the wastes which are determined to be hazardous, and a listing of the wastes which are determined to be extremely hazardous. When identifying such wastes the department shall consider, but not be limited to, the immediate or persistent toxic effects to man and wildlife and the resistance to natural degradation or detoxification of the wastes.

The reason being, the confinement of domestic wastewater underground has long been acceptable by regulatory agencies and no known listing of domestic waste by the State of California as hazardous so long as it is confined underground for natural treatment. Moreover, domestic waste does not contain chemicals as would be found in certain commercial and industrial waste discharge conditions.

Similarly, the conclusion is the same when evaluated within the context of the California Water Code § 13173 *id esta*:

> **13173**. "Designated waste" means either of the following: (a) Hazardous waste that has been granted a variance from hazardous waste management requirements pursuant to Section 25143 of the Health and Safety Code. (b) Nonhazardous waste that consists of, or contains, pollutants that, under ambient environmental conditions at a waste management unit, could be released in concentrations exceeding applicable water quality objectives or that could reasonably be expected to affect beneficial uses of the waters of the state as contained in the appropriate state water quality control plan.

The reason being, the advanced treatment at the head works and in the soil meets or exceeds the NSF Standard 40 parameters. These constructs are summarized as follows:

> ***<u>NSF/ANSI Standard 40</u>***
>
> Standard 40 is for residential wastewater treatment systems having rated capacities between 400 gallons (1514 Liters) and 1500 gallons (5678 Liters) per day. The standard includes a wide range of product evaluation methods and criteria for residential treatment systems. Most notably is the ability of the treatment system to produce an acceptable quality of effluent. This is demonstrated during a six month (26 week) test where wastewater of required strength is subjected to the system at the rated capacity of the system as evenly dosed at periods prescribed by the standard. Stress sequences are included to simulate wash day, working parent, power outage, and vacation conditions. The effluent criteria required of a Class I system is based on the U.S. EPA secondary effluent treatment requirements for municipal treatment

As before, the certification by the National Sanitation Foundation provides a finding of fact for effluent quality and treatment and regulatory design codes, inspection procedures and monitoring of the disposal system provide for maintaining the wastewater underground so as to not be a public nuisance. Moreover, the standards of the industry and the construction of this NSF 40 compliant system provides a high quality water with maximum benefits to the property owner and by extension, the people of the State.

A general argument is presented as an excerpt from the *US Environmental Protection Agency Onsite Treatment Systems Manual* (Chapter 3) as follows:

> **Ground Water Discharge**
>
> A conventional OWTS (septic tank and SWIS) discharges to ground water and usually relies on the unsaturated or vadose zone for final polishing of the wastewater before it enters the saturated zone. The septic tank provides primary treatment of the wastewater, removing most of the settleable solids, greases, oils, and other floatable matter and anaerobic liquifaction of the retained organic solids. The biomat that forms at the infiltrative surface and within the first few centimeters of unsaturated soil below the infiltrative field provides physical, chemical, and biological treatment of the SWIS effluent as it migrates toward the ground water.
>
> Because of the excellent treatment the SWIS provides, it is a critical component of onsite systems that discharge to ground water. Fluid transport from the infiltrative surface typically occurs through three zones, as shown in figure 3-10 (Ayres Associates, 1993a). In addition to the three zones, the figure shows a saturated zone perched above a restrictive horizon, a site feature that often occurs.
>
> Pretreated wastewater enters the SWIS at the surface of the infiltration zone. A biomat forms in this zone, which is usually only a few centimeters thick. Most of the physical, chemical, and biological treatment of the pretreated effluent occurs in this zone and in the vadose zone. Particulate matter in the effluent accumulates on the infiltration surface and within the pores of the soil matrix, providing a source of carbon and nutrients to the active biomass. New biomass and its metabolic by-products accumulate in this zone. The accumulated biomass, particulate matter, and metabolic by-products reduce the porosity and the infiltration rate through them. Thus, the infiltration zone is a transitional zone where fluid flow changes from saturated to unsaturated flow. The biomat controls the rate at which the pretreated wastewater moves through the infiltration zone in coarse- to medium-textured soils, but it is less likely to control the flow through fine-textured silt and clay soils because they may be more restrictive to flow than the biomat.
>
> Below the zone of infiltration lies the unsaturated or vadose zone. Here the effluent is under a negative pressure potential (less than atmospheric) resulting from the capillary

and adsorptive forces of the soil matrix. Consequently, fluid flow occurs over the surfaces of soil particles and through finer pores of the soil while larger pores usually remain air-filled. This is the most critical fluid transport zone because the unsaturated soil allows air to diffuse into the open soil pores to supply oxygen to the microbes that grow on the surface of the soil particles. The negative soil moisture potential forces the wastewater into the finer pores and over the surfaces of the soil particles, increasing retention time, absorption, filtration, and biological treatment of the wastewater.

From the vadose zone, fluid passes through the capillary fringe immediately above the ground water and enters the saturated zone, where flow occurs in response to a positive pressure gradient. Treated wastewater is transported from the site by fluid movement in the saturated zone. Mixing of treated water with ground water is somewhat limited because ground water flow usually is laminar. As a result, treated laminar water can remain as a distinct plume at the ground water interface for some distance from its source (Robertson et al., 1989). The plume might descend into the ground water as it travels from the source because of recharge from precipitation above. Dispersion occurs, but the mobility of solutes in the plume varies with the soil-solute reactivity.

Water quality-based performance requirements for ground water discharging systems are not clearly defined by current codes regulating OWTSs. Primary drinking water standards are typically required at a point of use (e.g., drinking water well) but are addressed in the codes only by requirements that the infiltration system be located a specified horizontal distance from the wellhead and vertical distance from the seasonal high water table. Nitrate nitrogen is the common drinking water pollutant of concern that is routinely found in ground water below conventional SWISs.

Contaminant attenuation

Contaminant attenuation (removal or inactivation through treatment processes) begins in the septic tank and continues through the distribution piping of the SWIS or other treatment unit components, the infiltrative surface biomat, the soils of the vadose zone, and the saturated zone. Raw wastewater composition was discussed in section 3.4 and summarized in table 3-7. Jantrania (1994) found that chemical, physical, and biological processes in the anaerobic environment of the septic tank produce effluents with TSS concentrations of 40 to 350 mg/L, oil and grease levels of 50 to 150 mg/L, and total coliform counts of 106 to 108 per 100 milliliters. Although biofilms develop on exposed surfaces as the effluent passes through piping to and within the SWIS, no significant level of treatment is provided by these growths. The next treatment site is the infiltrative zone, which contains the biomat. **Filtration, microstraining, and aerobic biological decomposition processes in the biomat and infiltration zone remove more than 90 percent of the BOD and suspended solids and 99 percent of the bacteria (University of Wisconsin, 1978).**

a. *<u>Wastewater Characterization</u>: A characterization of the wastewater for the following pollutants at a minimum:*

Total Dissolved Solids (TDS)……………………………………………
Total Nitrogen (N)
Chloride (Cl_2)
Sulfate (SO_4^{--})
Sodium (Na)
Iron (Fe ++ and Fe +++)
Manganese (Mn)
Methylene Blue Activated Substances(MBAS)
Boron (B)
Fluoride (F^-)
pH
Biological Oxygen Demand (BOD_5)
Total Suspended Solids (TDS)

Discussion:

Since the elements and chemical parameters often evaluated by the RWQCB are not part of the NSF testing paradigm, it would require an extensive and costly testing of the system. Only the pH (6.6 to 7.6), BOD_5 (200 mg./L average) and TDS (4 mg./L) analysis and findings are part of the NSF report. That being so, it is petitioned the findings by the NSF for compliance with ANSI/NSF Standard 40 be accepted in lieu of further testing. For comparative analysis, a table from the *USEPA Onsite Wastewater Treatment Systems Manual* follows:

Table 3-19. Wastewater constituents of concern and representative concentrations in the effluent of various treatment units

		Tank-based treatment unit effluent concentration					SWIS percolate into ground water at 3 to 5 ft depth (% removal
Constituents of concern	**Example direct or indirect measures (Units)**	**Domestic STE[1]**	**Domestic STE with N-removal recycle[2]**	**Aerobic unit effluent**	**Sand filter effluent**	**Foam or textile filter effluent**	
Oxygen demand	BOD_5 (mg/L)	140-200	80-120	5-50	2-15	5-15	>90%
Particulate solids	TSS (mg/L)	50-100	50-80	50-100	5-20	5-10	>90%
Nitrogen	Total N (mg N/L)	40-100	10-30	25-60	10-50	30-60	10-20%
Phosphorus	Total P (mg P/L)	5-15	5-15	4-10	<1-10[4]	5-15[4]	0-100%
Bacteria (e.g., Clostridium perfringens, Salmonella, Shigella)	Fecal coliform (organisms per 100 mL)	10^6-10^8	10^6-10^8	10^3-10^4	10^1-10^3	10^1-10^3	>99.99%
Virus (e.g., hepatitis, polio, echo, coxsackie, coliphage)	Specific virus (pfu/mL)	0-10^5episodically present at high levels)	0-10^5episodically present at high levels)	0-10^5episodically present at high levels)	0-10^5episodically present at high levels)	0-10^5episodically present at high levels)	>99.9%
Organic chemicals (e.g., solvents, petro-chemicals, pesticides)	Specific organics or totals (µg/L)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	>99%
Heavy metals (e.g., Pb, Cu, Ag, Hg)	Individual metals (µg/L)	0 to trace levels	0 to trace levels	0 to trace levels	0 to trace levels	0 to trace levels	>99%

[1]Septic tank effluent (STE) concentrations given are for domestic wastewater. However, restaurant STE is markedly higher

particularly in BOD_5, COD, and suspended solids while concentrations in graywater STE are noticeably lower in total nitrogen.
[2]N-removal accomplished by recycling STE through a packed bed for nitrification with discharge into the influent end of the septic tank for denitrification.
[3]P-removal by adsorption/precipitation is highly dependent on media capacity, P loading, and system operation.

Source: Siegrist, 2001 (after Siegrist et al., 2000)

Other potential pollutants and contaminants are discussed in the following excerpts from the *USEPA Onsite Wastewater Treatment Manual*, (Chapter 3).

Figure 3-16. Typical wastewater pollutants of concern

Pollutant	Reason for concern
Total suspended solids (TSS) and turbidity (NTU)	In surface waters, suspended solids can result in the development of sludge deposits that smother benthic macroinvertebrates and fish eggs and can contribute to benthic enrichment, toxicity, and sediment oxygen demand. Excessive turbidity (colloidal solids that interfere with light penetration) can block sunlight, harm aquatic life (e.g., by blocking sunlight needed by plants), and lower the ability of aquatic plants to increase dissolved oxygen in the water column. In drinking water, turbidity is aesthetically displeasing and interferes with disinfection.
Biodegradable organics (BOD)	Biological stabilization of organics in the water column can deplete dissolved oxygen in surface waters, creating anoxic conditions harmful to aquatic life. Oxygen-reducing conditions can also result in taste and odor problems in drinking water.
Pathogens	Parasites, bacteria, and viruses can cause communicable diseases through direct/indirect body contact or ingestion of contaminated water or shellfish. A particular threat occurs when partially treated sewage pools on ground surfaces or migrates to recreational waters. Transport distances of some pathogens (e.g., viruses and bacteria) in ground water or surface waters can be significant.
Nitrogen	Nitrogen is an aquatic plant nutrient that can contribute to eutrophication and dissolved oxygen loss in surface waters, especially in lakes, estuaries, and coastal embayments. Algae and aquatic weeds can contribute trihalomethane (THM) precursors to the water column that may generate carcinogenic THMs in chlorinated drinking water. Excesive nitrate-nitrogen in drinking water can cause methemoglobinemia in infants and pregnancy complications for women. Livestock can also suffer health impacts from drinking water high in nitrogen.
Phosphorus	Phosphorus is an aquatic plant nutrient that can contribute to eutrophication of inland and coastal surface waters and reduction of dissolved oxygen.
Toxic organics	Toxic organic compunds present in household chemicals and cleaning agents can interfere with certain biological processes in alternative OWTSs. They can be persistent in ground water and contaminate downgradient sources of drinking water. They can also cause damage to surface water ecosystems and human health through ingestion of contaminated aquatic organisms (e.g., fish, shellfish).
Heavy metals	Heavy metals like lead and mercury in drinking water can cause human health problems. In the aquatic ecosystem, they can also be toxic to aquatic life and accumulate in fish and shellfish that might be consumed by humans.
Dissolved inorganics	Chloride and sulfide can cause taste and odor problems in drinking water. Boron, sodium, chlorides, sulfate, and other solutes may limit treated wastewater reuse options (e.g., irrigation). Sodium and to a lesser extent potassium can be deleterious to soil structure and SWIS performance.

Source: Adapted in part from Tchobanoglous and Burton, 1991.

3.7.2 Fate and Transport of Pollutants in the Environment

When properly designed, sited, constructed, and maintained, conventional onsite wastewater treatment technologies effectively reduce or eliminate most human health or environmental threats posed by pollutants in wastewater (table 3-17). Most traditional systems rely primarily on physical, biological, and chemical processes in the septic tank and in the biomat and unsaturated soil zone below the SWIS (commonly referred to as a leach field or drain field) to sequester or attenuate pollutants of concern.

Table 3-17. Examples of soil infiltration system performance

Parameter	Applied concentration in milligrams per liter	Percent removal	References
BOD_5	130-150	90-98	Siegrist et al., 1986 U. Wisconsin, 1978
Total nitrogen	45-55	10-40	Reneau 1977 Sikora et al., 1976
Total phosphorus	8-12	85-95	Sikora et al., 1976
Fecal coliforms	NA[a]	99-99.99	Gerba, 1975

[a]Fecal coliforms are typically measured in other units, e.g., colony-forming units per 100 milliliters.

One study noted that fecal coliform bacteria moved 2 feet (0.6 meter) downward and 50 feet (15 meters) longitudinally 1 hour after being injected into a shallow trench in saturated soil on a 14 percent slope in western Oregon (Cogger, 1995). Contaminant plume movement on the surface of the saturated zone can be rapid, especially under sloping conditions, but it typically slows upon penetration into ground water in the saturated zone. Travel times and distances under unsaturated conditions in more level terrain are likely much less.

As the treated effluent passes through the biomat and into the vadose and saturated zones, other treatment processes (e.g., filtration, adsorption, precipitation, chemical reactions) occur. The following section discusses broadly the transport and fate of some of the primary pollutants of concern under the range of conditions found in North America. Table 3-18 summarizes a case study that characterized the septic tank effluent and soil water quality in the first 4 feet of a soil treatment system consisting of fine sand. Results for other soil types might be significantly different. Note that mean nitrate concentrations still exceed the 10 mg/L drinking water standard even after the wastewater has percolated through 4 feet of fine sand under unsaturated conditions. *

*This finding in the investigation has been addressed in the discussion as related to a mass balance approach which relies on basin area and dilution by internal water flows and precipitation.

Table 3-18. Case study: septic tank effluent and soil water quality[a]

Parameter (units)	Statistics	Septic tank effluent quality	Soil water quality[b] at 0.6 meter	Soil water quality[b] at 1.2 meters
BOD (mg/L)	Mean	93.5	<1	<1
	Range	46-156	<1	<1
	# samples	11	6	6
TOC (mg/L)	Mean	47.4	7.8	8.0
	Range	31-68	3.7-17.0	3.1-25.0
	# samples	11	34	33
TKN (mg/L)	Mean	44.2	0.77	0.77
	Range	19-53	0.40-1.40	0.25-2.10
	# samples	11	35	33
$N0_3$-N (mg/L)	Mean	0.04	21.6	13.0
	Range	0.01-0.16	1.7-39.0	2.0-29.0
	# samples	11	35	32
TP (mg/L)	Mean	8.6	0.40	0.18
	Range	7.2-17.0	0.01-3.8	0.02-1.80
	# samples	11	35	33
TDS (mg/L)	Mean	497	448	355
	Range	354-610	184-620	200-592
	# samples	11	34	32
CI (mg/L)	Mean	70	41	29
	Range	37-110	9-65	9-49
	# samples	11	34	31
F. Coli (log # per 100 mL)	Mean	4.57	nd[a]	nd
	Range	3.6-5.4	<1	<1
	# samples	11	24	21
F. strep. (log # per 100 mL)	Mean	3.60	nd	nd
	Range	1.9-5.3	<1	<1
	# samples	11	23	20

[a]The soil matrix consisted of a fine sand; the wastewater loading rate was 3.1 cm per day over 9 months. TOC = total organic carbon; TKN = total Kjeidahl nitrogen; TDS = total dissolved solids; CI = chloride;
F. coli = fecal coliforms; F. strep = fecal streptococci.
[b]Soil water quality measured in pan lysimeters at unsaturated soil depths of 2 feet (0.6 meter) and 4 feet (1.2 meters).
[c]nd = none detected.

Source: Adapted from Anderson et al., 19944.

Table 3-23. Case study: concentration of metals in septic tank effluent[a]

Metal constituent	Mean concentration (μg/L)	Range (μg/L)
Arsenic	37 (5)[b]	6-59
Barium	890 (5)	400-1310
Cadmium	83 (7)	30-330
Chromium	320 (7)	60-1400
Lead	2700 (1)	-
Mercury	2 (2)	1-3
Nickel	4000 (1)	-
Selenium	15 (6)	3-39

[a]Samples collected from the outlet of nine septic tanks.
[b]Number in parentheses indicates number of septic tanks in which metals were detected.

Source: Florida HRS, 1993, after Watkins, 1991.

Metals

The fate of metals in soil is dependent on complex physical, chemical, and biochemical reactions and interactions. The primary processes controlling the fixation/mobility potential of metals in subsurface infiltration systems are adsorption on soil particles and interaction with organic molecules. Because the amount of naturally occurring organic matter in the soil below the infiltrative surface is typically low, the cation exchange capacity of the soil and soil solution pH control the mobility of metals below the infiltrative surface. Acidic conditions can reduce the sorption of metals in soils, leading to increased risk of ground water contamination (Evanko, 1997; Lim et al., 2001). (See figure 3-11.) It is likely that movement of metals through the unsaturated zone, if it occurs at all, is accomplished by movement of organic ligand complexes formed at or near the infiltrative surface (Canter and Knox, 1985; Matthess, 1984).

Information regarding the transport and fate of metals in ground water can be found in hazardous waste and soil remediation literature (see http://www.gwrtac.org/html/Tech_eval.html#METALS). One study attempted to link septic tank systems to metal contamination of rural potable water supplies, but only a weak correlation was found (Sandhu et al., 1977). Removal of sources of metals from the wastewater stream by altering user habits and implementing alternative disposal practices is recommended. In addition, the literature suggests that improving treatment processes by increasing septic tank detention times, ensuring greater unsaturated soil depths, and improving dose and rest cycles may decrease risks associated with metal loadings from onsite systems (Chang, 1985; Evanko, 1997; Lim et al., 2001).

Surfactants

Surfactants are commonly used in laundry detergents and other soaps to decrease the surface tension of water and increase wetting and emulsification. Surfactants are the largest class of anthropogenic organic compounds present in raw domestic wastewater (Dental et al., 1993). Surfactants that survive treatment processes in the septic tank and subsequent treatment train can enter the soil and mobilize otherwise insoluble organic pollutants. Surfactants have been shown to decrease adsorption -- and even actively desorb -- the pollutant trichlorobenzene from soils (Dental, 1993). Surfactants can also change soil structure and alter wastewater infiltration rates.

Surfactant molecules contain both strongly hydrophobic and strongly hydrophilic properties and thus tend to concentrate at interfaces of the aqueous system including air, oily material, and particles. Surfactants can be found in most domestic septic tank effluents. Since 1970 the most common anionic surfactant used in household laundry detergent is linear alkylbenzene sulfonate, or LAS. Whelan and Titmanis (1982) found a range of LAS concentrations from 1.2 to 6.5 mg/L in septic tank effluent. Dental (1993) cited studies finding concentrations of LAS in raw wastewater ranging from 3 mg/L to 21 mg/L.

Because surfactants in wastewater are associated with particulate matter and oils and tend to concentrate in sludges in wastewater treatment plants (Dental, 1993), increasing detention times in the tank might aid in their removal. The behavior of surfactants in unsaturated soil is dependent on surfactant type. It is expected that minimal retention of anionic and nonionic surfactants occurs in unsaturated soils having low organic matter content. However, the degree of mobility is subject to soil solution chemistry, organic matter content of the soil, and rate of degradation by soil microorganisms. Soils with high organic matter should favor retention of surfactants because of the lipophilic component of surfactants. Surfactants are readily biodegraded under aerobic conditions and are more stable under anaerobic conditions. Substantial attenuation of LAS in unsaturated soil beneath a subsurface infiltration system has been demonstrated (Anderson et al., 1994; Robertson et al., 1989; Shimp et al., 1991). Cationic surfactants strongly sorb to cation exchange sites of soil particles and organic matter (McAvoy et al., 1991). Thus, fine-textured soils and soils having high organic matter content will generally favor retention of these surfactants.

Some investigations have identified the occurrence of methylene blue active substance (MBAS) in ground water (Perlmutter and Koch, 1971; Thurman et al., 1986). The type of anionic surfactant was not specifically identified. However, it was surmised that the higher concentrations noted at the time of the study were probably due to use of alkylbenzenesulfonate (ABS), which is degraded by microorganisms at a much slower rate than LAS. There has also been research demonstrating that all types of surfactants might be degraded by microorganisms in saturated sediments (Federle and Pastwa, 1988). **No investigations have been found that identify cationic or nonionic surfactants in ground water that originated from subsurface wastewater infiltration systems.** However, because of concerns over the use of alkylphenol polyethoxylates, studies of fate and transport of this class of endocrine disrupters are in progress.

Phosphorus

The fate and transport of phosphorus in soils are controlled by sorption and precipitation reactions (Sikora and Corey, 1976). At low concentrations (less than 5 mg/L), the phosphate ion is chemisorbed onto the surfaces of iron and aluminum minerals in strongly acid to neutral systems and on calcium minerals in neutral to alkaline systems. As phosphorus concentrations increase, phosphate precipitates form. Some of the more important precipitate compounds formed are strengite, $FePO_4 \cdot 2H_2O$; variscite, $AlPO_4 \cdot 2H_2O$; dicalcium phosphate, $CaHPO_4 \cdot 2H_2O$; octacalcium phosphate, $Ca_4H(PO_4)3 \cdot 3H2O$; and hydroxyapatite, $Ca_{10}(PO_4)_6(OH_2)$. In acidic soils, phosphate sorption probably involves the aluminum and iron compounds; in calcareous or alkaline soils, calcium compounds predominate.

The capacity of the soil to retain phosphorus is finite, however. With continued loading, phosphorus movement deeper into the soil profile can be expected. The ultimate retention capacity of the soil depends on several factors, including its mineralogy, particle size distribution, oxidation reduction potential, and pH. Fine-textured soils theoretically provide more sorption sites for phosphorus. As noted above, iron, aluminum, and calcium minerals in the soil allow phosphorus precipitation reactions to occur, a process that can lead to additional phosphorus retention. Sikora and Corey (1976) estimated that phosphorus penetration into the soil below a SWIS would be 52 centimeters per year in Wisconsin sands and 10 centimeters per year in Wisconsin silt loams.

Nevertheless, knowing the retention capacity of the soil is not enough to predict the travel of phosphorus from subsurface infiltration systems. Equally important is an estimate of the total volume of soil that the wastewater will contact as it percolates to and through the ground water. Fine-textured, unstructured soils (e.g., clays, silty clays) can be expected to disperse the water and cause contact with a greater volume of soil than coarse, granular soils (e.g., sands) or highly structured fine-textured soils (e.g., clayey silts) having large continuous pores. Also, the rate of water movement and the degree to which the water's elevation fluctuates are important factors.

There are no simple methods for predicting phosphorus removal rates

Table 3-21. Typical pathogen survival times at 20 to 30°C

Pathogens	Typical survival times in days: In fresh water & sewage	Typical survival times in days: In unsaturated soils
Viruses[a] Enteroviruses[b]	<120 but usually <50	<100 but usually <20
Bacteria		
Fecal coliforms[a]	<60 but usually <30	<70 but usually <20
Salmonella spp.[a]	<60 but usually <30	<70 but usually <20
Shigella spp.[a]	<30 but usually <10	
Protozoa *Entamoeba histolytica* cysts	<30 but usually <15	<20 but usually <10
Helminths *Ascaris lumbricoides* eggs	Many months	Many months

[a]In seawater, viral survival is less and bacterial survival is very much less than in fresh water.
[b]Includes polio-, echo-, and Coxsackie viruses.

Sources: Adapted from Feacham et al., 1983

Enteric bacteria are those associated with human and animal wastes. Once the bacteria enter a soil, they are subjected to life process stresses not encountered in the host. In most nontropical regions of the United States, temperatures are typically much lower; the quantity and availability of nutrients and energy sources are likely to be appreciably lower; and pH, moisture, and oxygen conditions are not as likely to be conducive to long-term survival. Survival times of enteric bacteria in the soil are generally reduced by higher temperatures, lower nutrient and organic matter content, acidic conditions (pH values of 3 to 5), lower moisture conditions, and the presence of indigenous soil microflora (Gerba et al., 1975). Potentially pathogenic bacteria are eliminated faster at high temperatures, pH values of about 7, low oxygen content, and high dissolved organic substance content (Pekdeger, 1984). The rate of bacterial die-off approximately doubles with each 10-degree increase of temperature between 5 and 30°C (Tchobanoglous and Burton, 1991). Observed survival rates for various potential pathogenic bacteria have been found to be extremely variable. Survival times of longer than 6 months can occur at greater depths in unsaturated soils where oligotrophic (low-nutrient) conditions exist (Pekdeger, 1984).

The main methods of bacterial retention in unsaturated soil are filtration, sedimentation, and adsorption (Bicki et al., 1984; Cantor and Knox, 1985; Gerba et al., 1975). Filtration accounts for the most retention. The sizes of bacteria range from 0.2 to 5 microns (m) (Pekdeger, 1984; Tchobanoglous and Burton, 1991); thus, physical removal through filtration occurs when soil micropores and surface water film interstices are smaller than this. Filtration of bacteria is enhanced by slow permeability rates, which can be caused by fine soil textures, unsaturated conditions, uniform wastewater distribution to soils, and periodic treatment system resting. Adsorption of bacteria onto clay and organic colloids occurs within a soil solution that has high ionic strength and neutral to slightly acid pH values (Canter and Knox, 1985).

Normal operation of septic tank/subsurface infiltration systems results in retention and die-off of most, if not all, observed pathogenic bacterial indicators within 2 to 3 feet (60 to 90 centimeters) of the infiltrative surface (Anderson et al., 1994; Ayres Associates, 1993a, c; Bouma et al., 1972; McGauhey and Krone, 1967). With a mature biomat at the infiltrative surface of coarser soils, most bacteria are removed within the first 1 foot (30 centimeters) vertically or horizontally from the trench-soil interface (University of Wisconsin, 1978). Hydraulic loading rates of less than 2 inches/day (5 centimeters/day) have also been found to promote better removal of bacteria in septic tank effluent (Ziebell et al., 1975). Biomat formation and lower hydraulic loading rates promote unsaturated flow, which is one key to soilbased removal of bacteria from wastewater. The retention behavior of actual pathogens in unsaturated soil might be different from that of the indicators (e.g., fecal coliforms) that have been measured in most studies.

Some reduction (less than 1 log) of virus concentrations in wastewater occurs in the septic tank. Higgins et al. (2000) reported a 74 percent decrease in MS2 coliphage densities, findings that concurs with those of other studies (Payment et al., 1986; Roa, 1981). Viruses can be both retained and inactivated in soil; however, they can also be retained but not inactivated. If not inactivated, viruses can accumulate in soil and subsequently be released due to changing conditions, such as prolonged peak OWTS flows or heavy rains. The result could be contamination of ground water. Soil factors that decrease survival include warm temperatures, low moisture content, and high organic content. Soil factors that increase retention include small particle size, high moisture content, low organic content, and low pH. Sobsey (1983) presents a thorough review of these factors. Virus removal below the vadose zone might be negligible in some geologic settings. (Cliver, 2000).

Various investigations have monitored the transport of viruses through unsaturated soil below the infiltration surface has been monitored by (Anderson et al., 1991; Hain and O'Brien, 1979; Jansons et al., 1989; Schaub and Sorber, 1977; Vaughn and Landry, 1980; Vaughn et al., 1981; Vaughn et al., 1982, 1983; Wellings et al., 1975). The majority of these studies focused on indigenous viruses in the wastewater and results were mixed. Some serotypes were found to move more freely than others. In most cases viruses were found to penetrate more than 10 feet (3 meters) through unsaturated soils. Viruses are less affected by filtration than bacteria (Bechdol et al., 1994) and are more resistant than bacteria to inactivation by disinfection (USEPA, 1990). Viruses have been known to persist in soil for up to 125 days and travel in ground water for distances of up to 1,339 feet (408 meters). However, monitoring of eight conventional individual home septic tank systems in Florida indicated that 2 feet (60 centimeters) of fine sand effectively removed viruses (Anderson et al., 1991; Ayres Associates, 1993c). Higgins (2000) reported 99 percent removal of virus particles within the first 1 foot (30.5 centimeters) of soil.

Recent laboratory and field studies of existing onsite systems using conservative tracers (e.g., bromide ions) and microbial surrogate measures (e.g., viruses, bacteria) found that episodic breakthroughs of virus and bacteria can occur in the SWIS, particularly during early operation (Van Cuyk et al., 2001). Significant (e.g., 3-log) removal of viruses and near complete removal of fecal bacteria can be reasonably achieved in 60 to 90 centimeters of sandy media (Van Cuyk et al., 2001).

Inactivation of pathogens through other physical, chemical, or biological mechanisms varies considerably. Protozoan cysts or oocysts are generally killed when they freeze, but viruses are not. Ultraviolet light, extremes of pH, and strong oxidizing agents (e.g., hypochlorite, chlorine dioxide, ozone) are also effective in killing or inactivating most pathogens (Cliver, 2000). Korich (1990) found that in demandfree water, ozone was slightly more effective than chlorine dioxide against Cryptosporidium parvum oocysts, and both were much more effective than chlorine or monochloramine. C. parvum oocysts were found to be 30 times more resistant to ozone and 14 times more resistant to chlorine dioxide than are Giardia lamblia cysts (Korich et al., 1990).

Toxic organic compounds

A number of toxic organic compounds that can cause neurological, developmental, or other problems in humans and interfere with biological processes in the environment can be found in septic tank effluent. Table 3-22 provides information on potential health effects from selected organic chemicals, along with USEPA maximum containment levels for these pollutants in drinking water. The toxic organics that have been found to be the most prevalent in wastewater are 1,4-dichlorobenzene, methylbenzene (toluene), dimethylbenzenes (xylenes), 1,1-dichloroethane, 1,1,1-trichloroethane, and dimethylketone (acetone). These compounds are usually found in household products like solvents and cleaners.

Table 3-22. Maximum contaminant levels (MCLs) for selected organic chemicals in drinking water

Contaminant	MCL (mg/L)	Potential health effects
Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer
Chlordane	0.002	Liver or nervous system problems; increased risk of cancer
Chlorobenzene	0.1	Liver or kidney problems
2,4-D	0.07	Liver, kidney, or adrenal gland problems
o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems
1,2-Dichloroethane	0.005	Increased risk of cancer
Dichloromethane	0.005	Liver problems, increased risk of cancer
Dioxin	0.00000003	Reproductive difficulties; increased risk of cancer
Ethylbenzene	0.7	Liver or kidney problems
Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer
Lindane	0.0002	Liver or kidney problems
Toluene	1.0	Nervous system, kidney, or liver problems
Trichloroethylene	0.005	Liver problems; increased risk of cancer
Vinyl chloride	0.002	Increased risk of cancer
Xylenes (total)	10	Nervous system damage

Source: USEPA, 2000a

No known studies have been conducted to determine toxic organic treatment efficiency in single-family home septic tanks. In this case, the effluent is opined to be similar to domestic waste i.e. church wastewater is opined to have similar constituents as compared to "commercial wastes which would be site specific. .A study of toxic organics in domestic wastewater and effluent from a community septic tank found that removal of low molecular-weight alkylated benzenes (e.g., toluene, xylene) was noticeable, whereas virtually no removal was noted for higher-molecular-weight compounds (DeWalle et al., 1985). Removal efficiency was observed to be directly related to tank detention time, which is directly related to settling efficiency.

The behavior of toxic organic compounds in unsaturated soil is not well documented. The avenues of mobility available to toxic organics include those which can transport organics in both gaseous and liquid phases. In the gaseous phase toxic organics diffuse outward in any direction within unobstructed soil voids; in the liquid phase they follow the movement of the soil solution. Because of their nonpolar nature, certain toxic organics are not electrochemically retained in unsaturated soil. Toxic organics can be transformed into less innocuous forms in the soil by indigenous or introduced microorganisms. The biodegradability of many organic compounds in the soil depends on oxygen availability. Halogenated straight-chain compounds, such as many chlorinated solvents, are usually biodegraded under anaerobic conditions when carbon dioxide replaces oxygen (Wilhelm, 1998). Aromatic organic compounds like benzene and toluene, however, are biodegraded primarily under aerobic conditions. As for physical removal, organic contaminants are adsorbed by solid organic matter. Accumulated organic solids in the tank and in the soil profile, therefore, might be important retainers of organic contaminants. In addition, because many of the organic contaminants found in domestic wastewater are relatively volatile, unsaturated conditions in drain fields likely facilitate the release of these compounds through gaseous diffusion and volatilization (Wilhelm, 1998).

Rates of movement for the gaseous and liquid phases depend on soil and toxic organic compound type. Soils having fine textures, abrupt interfaces of distinctly different textural layers, a lack of fissures and other continuous macropores, and low moisture content retard toxic organic movement (Hillel, 1989). If gaseous exchange between soil and atmosphere is sufficient, however, appreciable losses of low-molecular-weight alkylated benzenes such as toluene and dimethylbenzene (xylene) can be expected because of their relatively high vapor pressure (Bauman, 1989). Toxic organics that are relatively miscible in water (e.g., methyl tertiary butyl ether, tetrachloroethane, benzene, xylene) can be expected to move with soil water. Nonmiscible toxic organics that remain in liquid or solid phases (chlorinated solvents, gasoline, oils) can become tightly bound to soil particles (Preslo et al., 1989). Biodegradation appears to be an efficient removal mechanism for many volatile organic compounds. Nearly complete or complete removal of toxic organics below infiltration systems was found in several studies (Ayres Associates, 1993a, c; Robertson, 1991; Sauer and Tyler, 1991).

Some investigations have documented toxic organic contamination of surficial aquifers by domestic wastewater discharged from community infiltration fields (Tomson et al., 1984). Of the volatile organic compounds detected in ground water samples collected in the vicinity of subsurface infiltration systems, Kolega (1989) found trichloromethane, toluene, and 1,1,1-trichloroethane most frequently and in some of the highest concentrations. Xylenes, dichloroethane, and dichloromethane were also detected.

Once toxic organics reach an aquifer, their movement generally follows the direction of ground water movement. The behavior of each within an aquifer, however, can be different. Some stay near the surface of the aquifer and experience much lateral movement. Others, such as aliphatic chlorinated hydrocarbons, experience greater vertical movement because of their heavier molecular weight (Dagan and Bresler, 1984). Based on this observation, 1,4- dichlorobenzene, toluene, and xylenes in septic tank effluent would be expected to experience more lateral than vertical movement in an aquifer; 1,1-dichloroethane, 1,1,1-trichloroethane, dichloromethane, and trichloromethane would be expected to show more vertical movement. Movement of toxic organic compounds is also affected by their degree of solubility in water. Acetone, dichloromethane, trichloromethane, and 1,1-dichloroethane are quite soluble in water and are expected to be very highly mobile; 1,1,1-trichloroethane, toluene, and 1,2-dimethylbenzene (o-xylene) are expected to be moderately mobile; and 1,3-dimethylbenzene (m-xylene), 1,4-dimethylbenzene (p-xylene), and 1,4-dichlorobenzene are expected to have low mobility (Fetter, 1988).

System design considerations for removing toxic organic compounds include increasing tank retention time (especially for halogenated, straight-chain compounds like organic solvents), ensuring greater vadose zone depths below the SWIS, and placing the infiltration system high in the soil profile, where higher concentrations of organic matter and oxygen can aid the volatilization and treatment of aromatic compounds. It should be noted that significantly high levels of toxic organic compounds can cause die-off of tank and biomat microorganisms, which could reduce treatment performance.

Metals

Some information is available regarding metals in septic tank effluent (DeWalle et. al. 1985). Metals can be present in raw household wastewater because many commonly used household products contain metals. Aging interior plumbing systems can contribute lead, cadmium, and copper (Canter and Knox, 1985). Other sources of metals include vegetable matter and human excreta. Several metals have been found in domestic septage, confirming their presence in wastewater. They primarily include cadmium, copper, lead, and zinc (Bennett et al., 1977; Feige et al., 1975; Segall et al., 1979). OWTSs serving nonresidential facilities (e.g., rural health care facilities, small industrial facilities) can also experience metal loadings. Several USEPA priority pollutant metals have been found in domestic septic tank effluent (Whelan and Titmanis, 1982). The most prominent metals were nickel, lead, copper, zinc, barium, and chromium.

Treatment System:

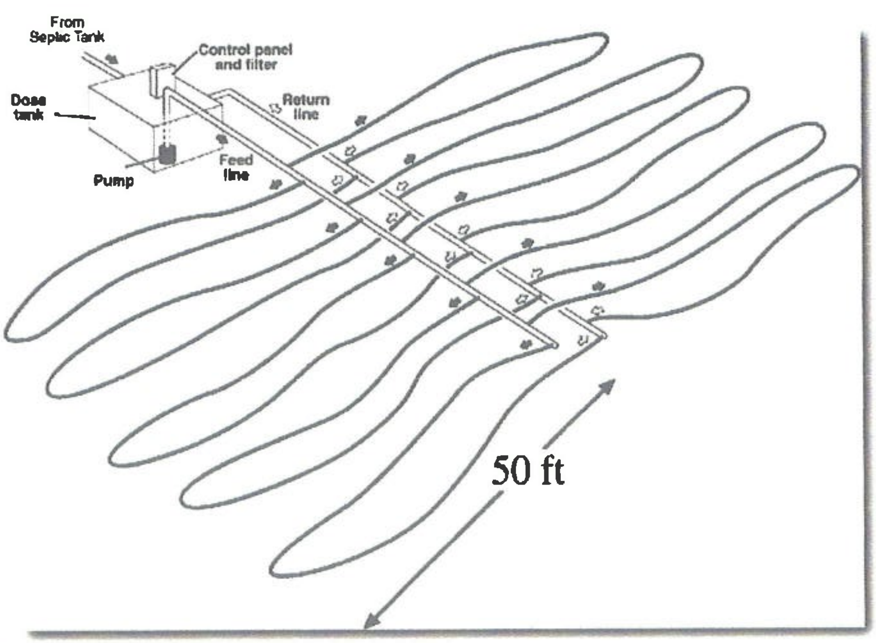
The treatment train is a proprietary sequence which begins with the wastewater flowing into a septic tank where it separates into scum, sludge, and liquid effluent. Filtered effluent then flows to treatment chamber. As the effluent trickles through sheets of a synthetic textile, a substrate develops for microorganisms to digest the wastewater.

The effluent is then pumped to the soil via a "subsurface drip irrigation" (SDS) system.

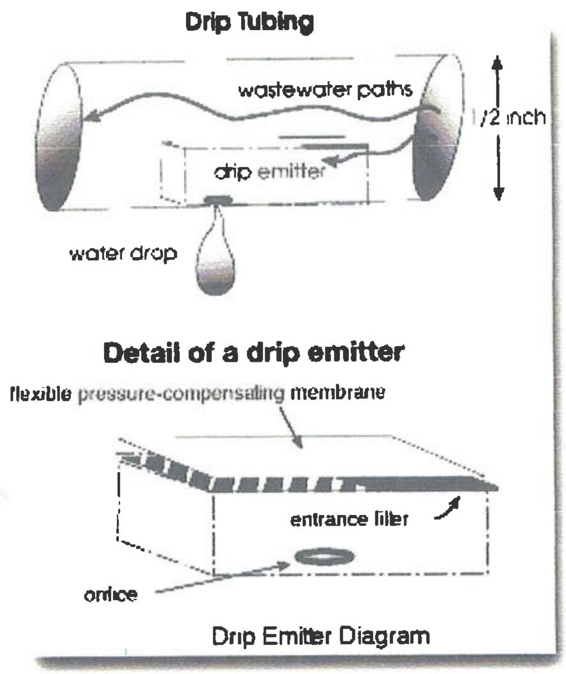
The SDS is a pressurized wastewater distribution system that can deliver small, precise doses of effluent to shallow subsurface disposal fields (small diameter, flexible polyethylene tubing i.e. a drip line which has small inline emitters that discharge effluent at slow, controlled rates. The drip-line can be installed by trenching into narrow and shallow trenches (usually 6-9" deep) and backfilled without drain rock or geo-textile. The drip line is treated with a root growth inhibitor to prevent root intrusion through the emitters.

After the effluent travels through the head-works unit, the drip-line zone or zones get pressurized and emit the effluent at slow rates evenly throughout the drip zone or zones. At the drip zone's highest point, a vacuum breaker is used to help prevent soil particles from being sucked into the emitters after dosing and to allow the piping to drain between doses by negating the pump suction.

Although a review of the engineered layout and design should be referenced for specifics, the following schematic shows a "general overview" of the head works and the subsurface drip distribution system.



Source: University of Wisconsin



Details of the Tubing and Drip Emitters Used in a Drip-distribution System
Source: www.orenco.com

Regarding the disposition of waste which is not digested and discharged as effluent for distribution in the soil matrix, a maintenance program will be implemented so as to have sludge and scum removed by a licensed pumper/hauler when the sludge depth approaches a nominal 30% of volume in the tank.

The filters need to be cleaned manually or exchanged at least once a year. Because a series of pressure-release valves senses when the holes in the drip tubing are plugged with solids, the system back-flushes the tubing on a regular basis, but may need to be back-flushed manually if this does not eliminate the problem. The tubing itself may have to be replaced if jetting and/or flushing does not resolve clogging.

Moreover, the control panel monitors pressure changes across the system, as well as system temperature, pump performance, and daily flow. This allows the discovery of potential problems before they occur.

Best Management Practices (BMP):

The BMP constructs for this project will be directed to activities during construction of the dwelling. They will incorporate the standards of the industry and San Diego County requirements as conditions of building permits and an approved grading plan. The County of San Diego provides guidelines for BMP's which are used when engineering the construction site.

The BMP measures used for approved grading and pad construction will insure no impacts to any nearby wetlands or habitat, offsite and/or downstream erosion nor any offsite receiving waters, then consequently: there would be no degradation of water quality objectives for the basin.

Moreover, the confinement of the wastewater underground for subsurface treatment and disposal in accordance with the design and use of an NSF certified disposal system is argued as an acceptable BMP for onsite wastewater disposal.

Attachment "B"

List of Constituents & Discharge Concentrations

Background

A primary issue for assessment of subsurface discharge of wastewater is the potential impact on the natural occurring groundwater aquifer. This construct is regulated by the Porter Cologne Water Quality Control Act of 1967. The California Water Code Section 13000 *et seq.*, requires the *Regional Water Quality Control Board* to adopt water quality criteria to protect State waters. These criteria include the identification of beneficial uses, narrative and numerical water quality standards, and implementation procedures. The California Water Code §13260 requires further supports these goals with regulatory demands that any person discharging waste, or proposing to discharge waste, within any region that could affect the quality of the waters of the State, other than into a community sewer system, must submit a report of waste discharge to the applicable RWQCB. Any actions related to the proposed Project applicable to California Water Code §13260 would be reported to the RWQCB. (In this case, "Region 9").

In this discussion, the argument for accepting the advanced treatment system hereafter referenced as "Jet Inc." will be a comparison of conventional disposal system chemistry in the treatment zone of soil with the effluent claims of "Jet Inc."

Primary constituents of interest as a result of wastewater treatment are as follows:

Natural Soil Treatment – Conventional Septic Disposal

Constituent	Soil Water Quality at	
	24 inches	48 inches
5-day biological oxygen demand	<1 mg/L	<1 mg/L
Total Kjeldahl Nitrogen (TKN)	0.77 mg/L	0.77 mg/L
Total Nitrogen (TN)	21 mg/L	
Nitrites & Nitrates (NO_3-N)	21.6 mg/L	13.0 mg/L
Total Phosphorus	.01 – 3.8 mg/L	.02 – 1.8 mg/L
Fecal Coliform	<1 MPN/100mL	<1 PN/100mL

Source: USEPA Onsite Treatment Systems Manual, Chapter 3, 2002 adapted from Anderson et. al., 1994

These data can be compared to the treatment by the *Jet Inc.* "advanced treatment system" with independent findings by *Golf Coast Testing, LLC.* This company conducts testing and specific performance to determine if treatment meets or exceeds NSF/ANSI Standard 245 (2010a). The test consists of three weeks dosing with sampling to allow for plant start-up, sixteen weeks of dosing at design flow, seven and a half weeks of a stress test and an additional two and one half weeks of dosing at design flow.

Because "commercial system" do not have the predictable effluent character as do domestic waste sources, there are no NSF standards. The system used for this project with parallel modules is argued as having comparable wastewater as a residential system and is therefore proposed as applicable.

The *Jet Inc.* system (fixed film) not only meets or exceeds the 30-30-50 protocol, but has documentation of 70-90% reduction in "Total Nitrogen" (average 72.6% reduction of NO3-N).

Alkalinity as $CaCO_3$ and pH could be of interest because they can be useful in predicting absorbent characteristics of soil (particularly when the soil has slow absorbency as would be the case of clay). This chemistry is not discussed in this petition because the disposal area is a sandy loam and has good percolation.

Given the National Sanitation Foundation (NSF) findings for certification, it is also argued this proposed installation will not have a deleterious impact on the local water quality objectives. This is further supported for eutrophication issues because the effluent will be confined underground and/or nutrients absorbed by subsurface agronomic uptake.

The objectives of the Regional Board for the Ramona Hydrologic Unit Basin Number 905.00 and the related sub-basins can be found on Table 3-2 in Chapter 3 of the Region 9 Basin Plan.

In my professional opinion and academic background in chemistry and microbiology, I cannot think of any analyte nor microorganism which would compromise the objectives of the basin plan by dispersal of wastewater on this site.

This is premised on (a) the advanced treatment system meets the standards of the National Sanitation Foundation, (b) groundwater separation is not an issue and (c) there is at least a fifty foot setback from natural drainage which allows for an unsaturated barrier. Moreover, the unsaturated soil allows for absorption and adsorption of chemical constituents, deactivates viruses and allows saprophytic soil bacteria to outcompete pathogenic microorganisms which depend on body temperature to metabolize.

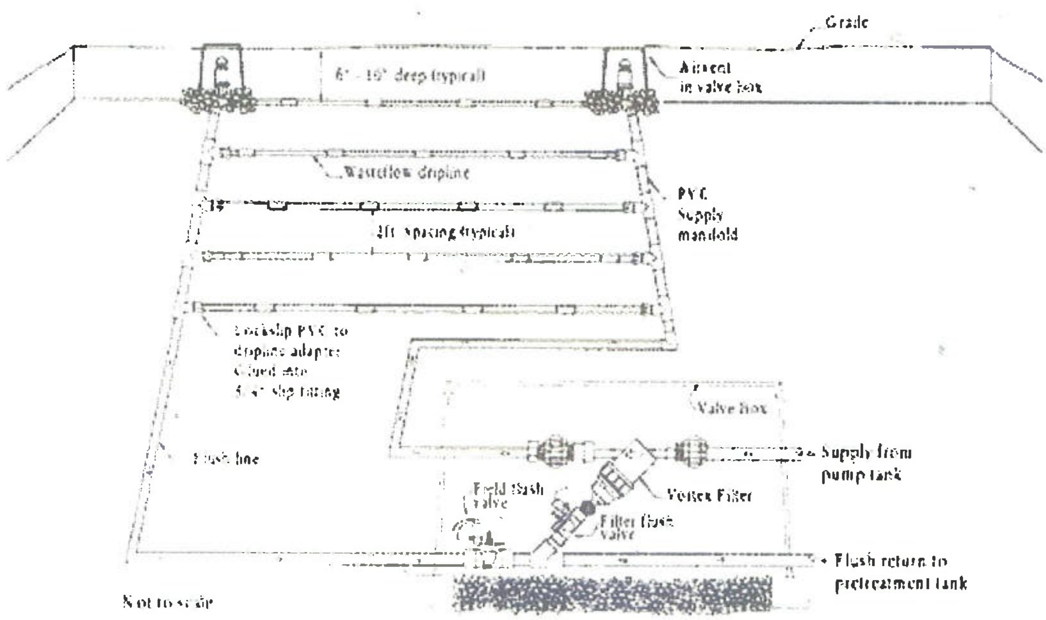
Treatment Processes.................*Attachment "C"*

(including disposal method)

The facility discharges wastewater to a 2500 gallon "trash tank" (actually a *Jensen Precast* Septic Tank) which provides preliminary removal of solids. This tank discharges to a distribution box for equal flow to a *Jet Inc.* J-1250 module of two of treatment tanks in series.

The J-1250 model has two treatment compartments. Each has an aeration chamber with a spinning aspirator for aeration and " honeycombed" fixed film growth medium. The third compartment is a settling chamber from which solids are collected and recirculated to the second chamber.

Discharge from this treatment system is collected in a 2500 gallon *Procast Products* septic tank (modified to allow a 24 hour storage capacity and also accommodate timed dosing with an engineered pump delivery system to a subsurface drip dispersal field). See Drawing...



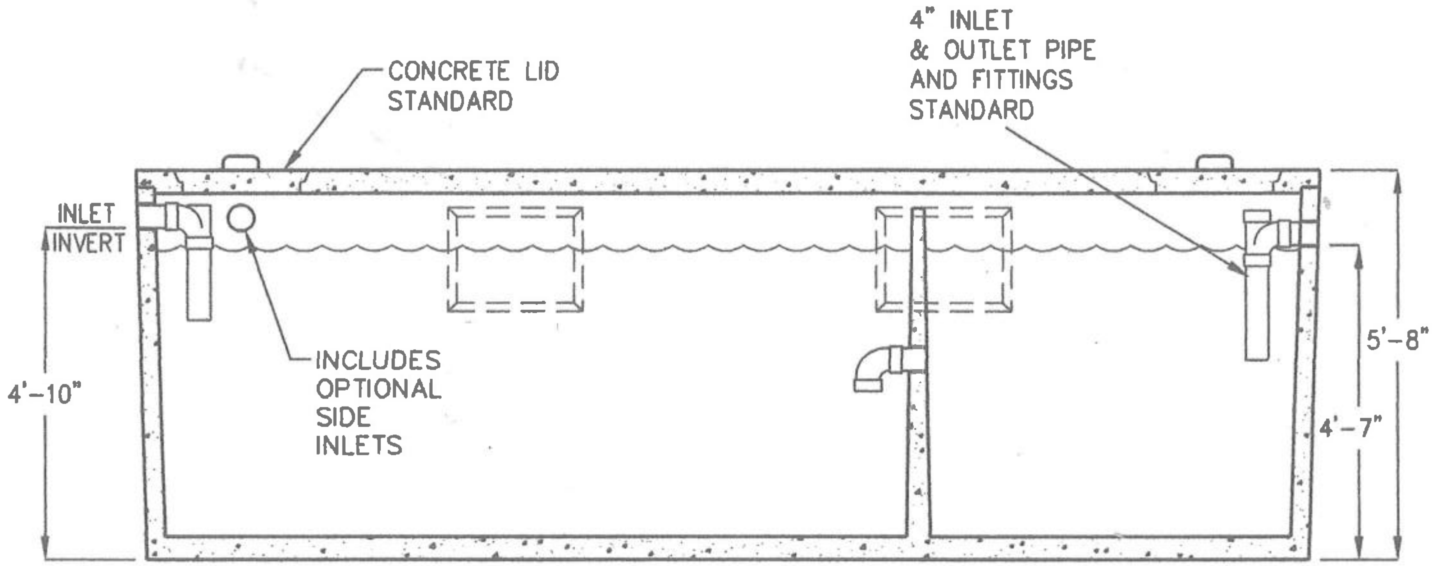
Appended schematic drawing and specifications are as follows:

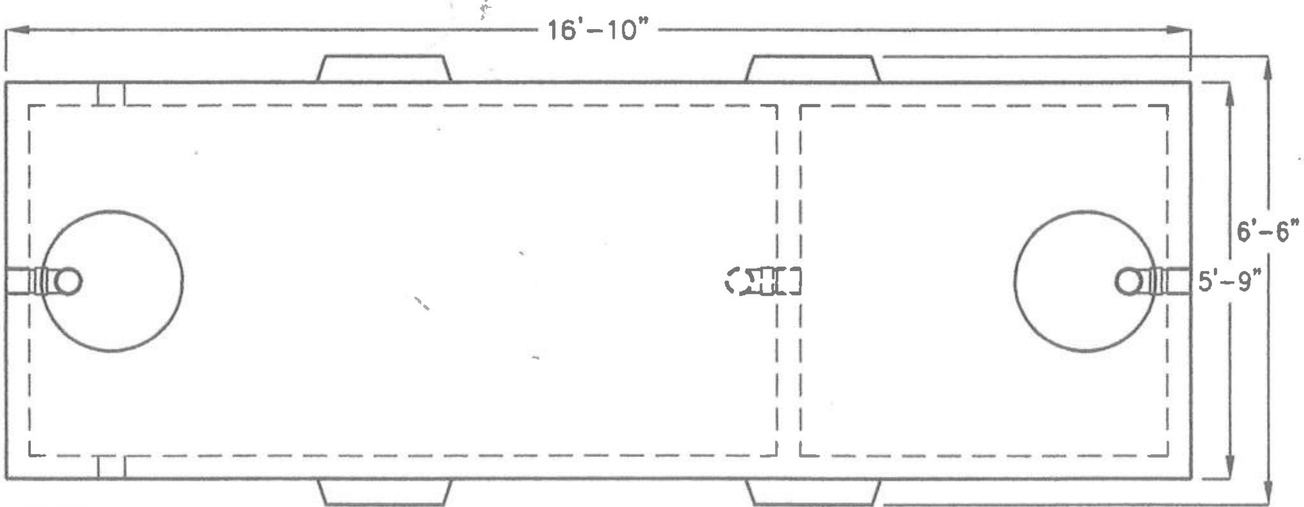
1. *Jet Inc.* 1250 GPD Plant Component Parts & Installation
2. *Jensen Precast* Septic Tank
3. *Procast* Septic Tank
4. *Geoflow* Components for the Dispersal System

JS-2500 GALLON
RESIDENTAL SEPTIC TANK

MODEL JS2500
ACCEPTED BY UPC®

SIDE VIEW
CUTAWAY





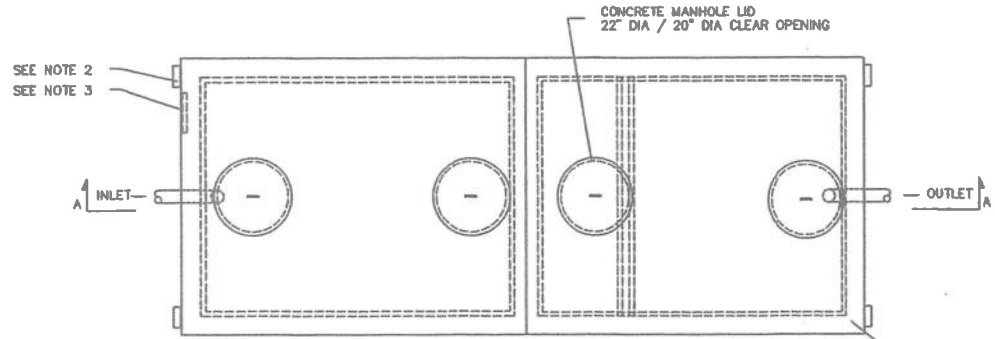
TOP VIEW

LIQUID CAPACITY: 2500 GALLONS
BOX DESIGN LOAD: NON-TRAFFIC, 3 FEET
OF SOIL COVER, MAXIMUM OF 500 PSF.

FOR COMPLETE DESIGN
AND PRODUCT INFORMATION
CONTACT JENSEN PRECAST.

7/13/05
JS2500_B.dwg

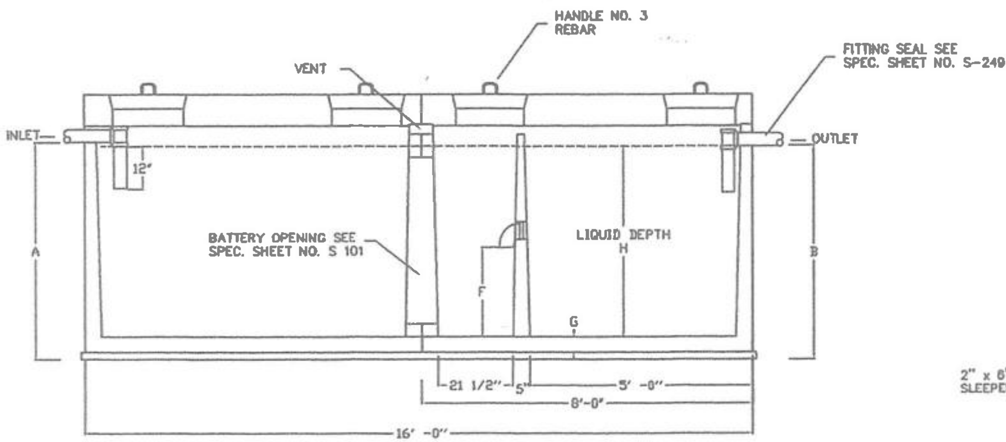
JENSEN PRECAST®



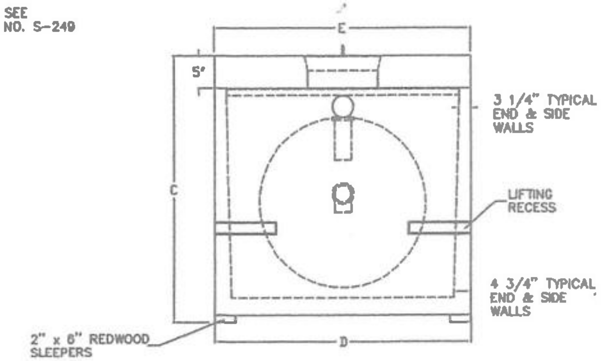
PLAN VIEW

NOTES:

1. REFER TO SPECIFICATION SHEET NO. S-204
2. REFER TO SPECIFICATION SHEET NO. S-252
3. REFER TO SPECIFICATION SHEET NO. S-251



SECTION A-A



OUTLET
END VIEW

SEPTIC TANK WITH FOUR MANHOLES
DESIGNED FOR 3 FOOT EARTH COVER
OR 360 PSF LOADINGS

2000 THRU 3000 GALLONS

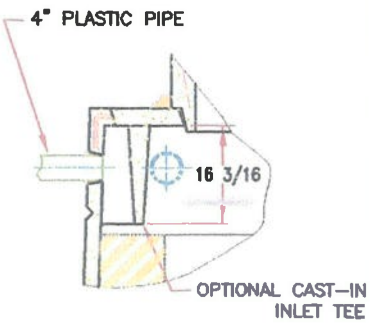
ALL DIMENSIONS IN INCHES AND WEIGHT IN LB									
MODEL	A	B	C	D	E	F	G	H	WEIGHT
PC G-2000	51	48	62	74	75	20 3/4	4 1/2	41 1/2	24,000
PC G-2500	60	57	71	74	75	25 1/4	4 1/2	50 1/2	26,175
PC G-3000	63 1/2	60 1/2	74 1/2	85	86	26 3/4	5	53 1/2	27,025

EXCAVATION SPECIFICATIONS				
MODEL	S-2000	S-2500	S-3000	
LENGTH	21'-0"	21'-0"	21'-0"	
WIDTH	10'-0"	10-0"	11'-0"	
BELOW INLET	4'-2"	4'-11"	5"-2 1/2"	
TANK HEIGTH	5'-2"	5'-11"	6'-2 1/2"	

Pro-Cast PRODUCTS INC.
P.O. BOX 602
HIGHLAND, CA 92346
909 793-7602 800 945-8265
Fax: 909 793-1283

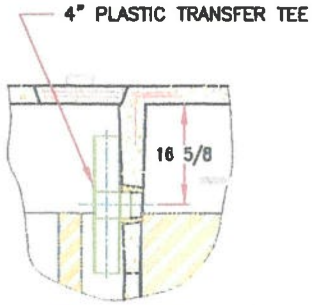
DATE:	DRAWN BY:	SCALE:	DWG #
01-10-13	M.RAHMAN	1" = 1'	S-1003

DETAIL 1



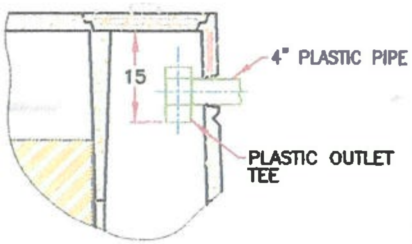
OPTIONAL INLET TEE

DETAIL 2

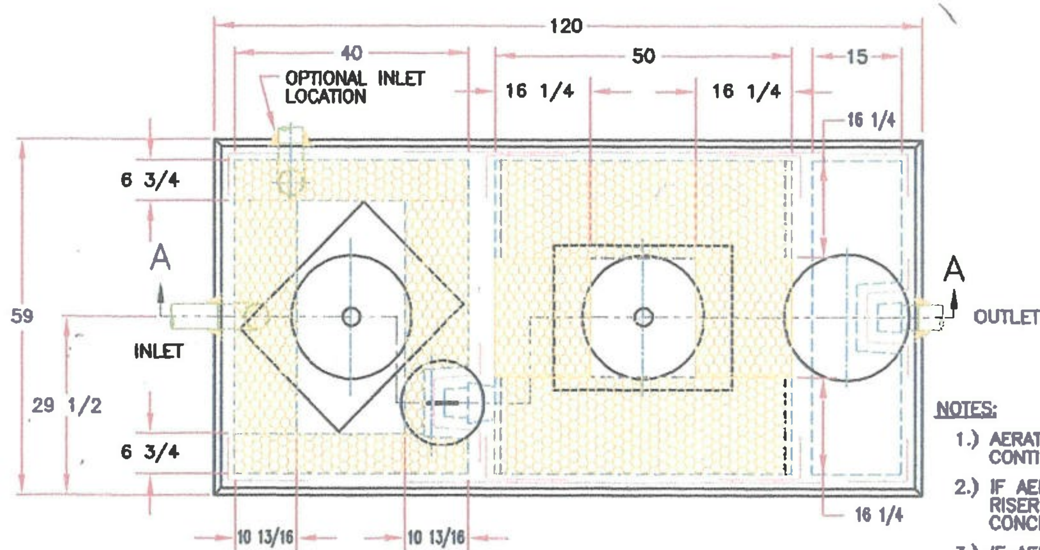


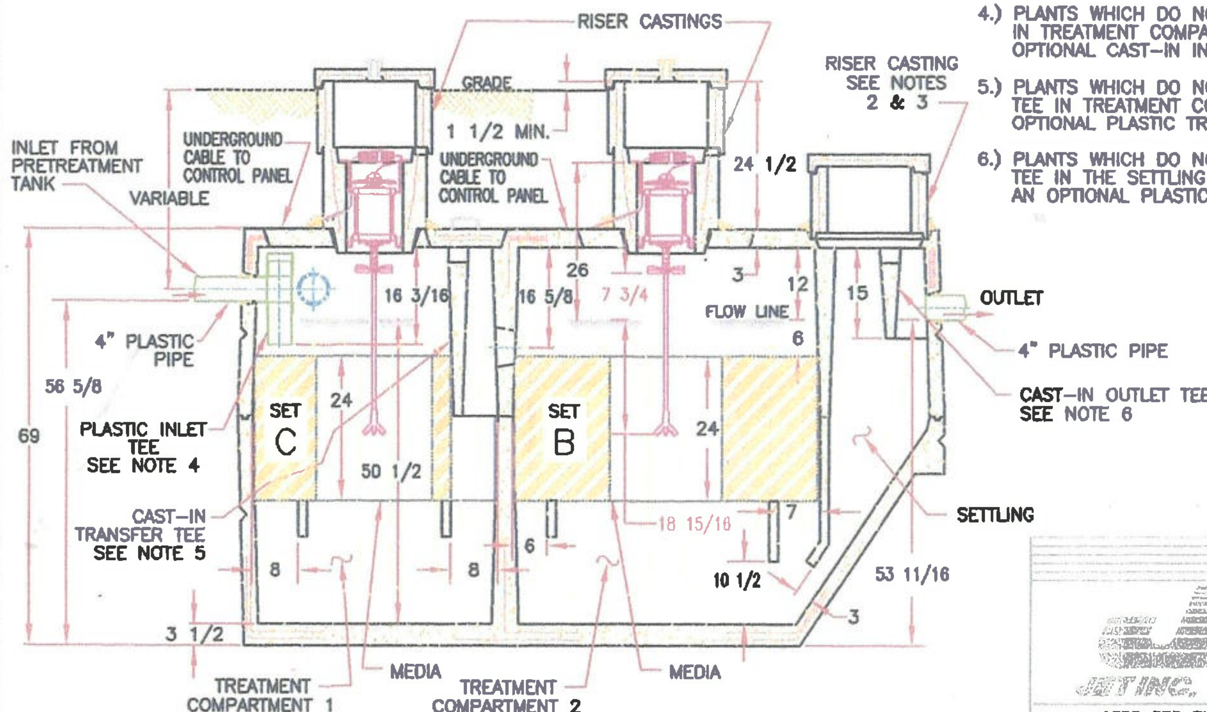
OPTIONAL TRANSFER TEE

DETAIL 3



OPTIONAL OUTLET TEE





SECTION A-A

NOTES:

1.) AERATOR MODEL 700LL IN CYCLED OR CONTINUOUS OPERATION MUST BE USED.

2.) IF AERATOR MOUNTING CASTINGS HAVE NO RISERS, RISERS ARE NOT REQUIRED HERE. A REMOVABLE CONCRETE COVER IS REQUIRED.

3.) IF AERATOR MOUNTING CASTINGS HAVE RISERS, COVERED RISERS ARE REQUIRED HERE. RISERS SHOULD BE DEVELOPED TO GRADE OR TO 6"-12" BELOW GRADE.

4.) PLANTS WHICH DO NOT USE A PLASTIC INLET TEE IN TREATMENT COMPARTMENT 1 MAY USE AN OPTIONAL CAST-IN INLET TEE. SEE DETAIL 1.

5.) PLANTS WHICH DO NOT HAVE A CAST-IN TRANSFER TEE IN TREATMENT COMPARTMENT 1 MAY USE AN OPTIONAL PLASTIC TRANSFER TEE. SEE DETAIL 2.

6.) PLANTS WHICH DO NOT HAVE A CAST-IN OUTLET TEE IN THE SETTLING COMPARTMENT MAY USE AN OPTIONAL PLASTIC OUTLET TEE. SEE DETAIL 1.

JET INC.	REVISED: 05-18-01f
	DRAWN BY: R. P. T.
	APPROVED BY: D.S.M.
1250 GPD PLANT COMPONENT PARTS & INSTALLATION	DATE: 3-15-94
©MMI JET INC. D 12	SCALE: NONE
PATENTED	DRAWING NUMBER: J-1250

FILE REF. No. ART-451-7

SYSTEM COMPONENTS

A typical drip system installation will consist of the elements listed below:

1. Wasteflow® Dripline

(See product sheet for specification)
WASTEFLOW dripline carries the water into the dispersal/reuse area. The dripline is connected to the supply and return manifolds with Compression or Lockslip fittings. Typical spacing between each dripline and between drip emitters is 24" on center. Standard coil length is 500-ft.

Wasteflow dripline features:

a.) nano-Rootguard®
In 2008 Wasteflow dripline will have new nano-ROOTGUARD which has an extended expected life of 30 years. The risk of root intrusion with an emitter slowly releasing nutrient rich effluent directly into the soil is well known to anyone who has observed a leaking sewer pipe. All Geoflow drip emitters are guaranteed to be protected against root intrusion with nano-Rootguard. This patented process fuses the root-growth inhibitor, Treflan® into each drip emitter during manufacturing. Treflan is registered with the United States EPA for this application. The nano-Rootguard technology holds Treflan for extended time inside the plastic, slowly releasing it in minute quantities to prevent root cells from dividing and growing into the barrier zone. It is chemically degradable, non-systemic, and virtually insoluble in water (0.3 ppm). nano-Rootguard carries a **15-year warranty** against root intrusion.

b.) ***Geoshield™*** protection
GEOFLOW's Wasteflow has an inner lining impregnated with an antimicrobial, Tributyl tin maleate, to inhibit adhesion of biological growth on the inside walls of the tube and on the emitters. It does not have any measurable biological effect on the effluent passing through the tube. This minimizes the velocity required to flush Wasteflow dripline. The velocity only needs to move out the fine particles that pass through the 130 micron filter that, if not flushed, will ultimately accumulate at the distal end of each lateral. It is not necessary to scour growth off the inside wall of Wasteflow tubing. Since all pumps deliver more volume given less resistance to flow, just opening the flush valve will usually achieve this degree of flushing. When a minimum flushing velocity is requested by regulators, 0.5 feet per second is used with Wasteflow dripline to get the settled particles at the bottom of the pipe back into suspension. This equates to 0.375 gpm per dripline when using standard WASTEFLOW dripline (0.55"ID)

c.) Turbulent Flow Path
Wasteflow drip emitters are pre-inserted in the tube usually spaced 6", 12",

18", or 24" apart with 24" being the most popular. Angles in the emitter flow path are designed to cause turbulence in order to equalize flow between emitters and keep the emitters clean. Geoflow emitters boast large flow paths, which, coupled with turbulent flow, have proven over the years to be extremely reliable and dependable.

d.) Wasteflow Classic and Wasteflow PC Dripline

Both WASTEFLOW Classic and WASTEFLOW PC have turbulent flow path emitters with nano-ROOTGUARD and *Geoshield* protection. The WASTEFLOW PC has the added element of a silicone rubber diaphragm that moves up and down over the emitter outlet to equalize flows regardless of pressure between 7 and 60 psi. To ensure a long life the recommended operating range is 10 to 45 psi. For Wasteflow Classic, the flow rate delivered by the emitter is a function of the pressure at the emitter. The Classic dripline has the advantage of no moving parts or rubber that may degrade over time. Also, when minimum flushing velocities are required, the flows during a dosing cycle and flushing cycle are very similar with the Wasteflow Classic because when the flush valve is opened, the pressure is reduced, causing the flows from the emitters to decline. PC dripline requires significantly higher flow for flushing than dosing as the emitter flow does not go down during the flushing cycle. We generally recommend using WASTEFLOW Classic, unless the economic advantages to using PC is substantial.

i . Wasteflow PC can run longer distances than Wasteflow Classic.

ii. Steep slopes. Systems should be designed for the dripline lateral to follow the contour. When this is practical, the extra cost of installing pressure regulators required for Wasteflow Classic would likely be less than the incremental cost of Wasteflow PC.

iii. Rolling terrain. If the difference in height from trough to peak exceeds six feet Wasteflow PC be used. Vacuum relief valves must be placed at the top of each rise.

2. Controllers

(See product sheet for specification)

Controllers are used for time dosing and time flushing of the filter and dripfields. GEO controllers include a programmable logic controller to increase flexibility and reliability in the field. They can be used on systems ranging in size from one to eight zones at the time this manual was printed. All controllers include a surge arrestor, elapsed time meter and counter. In 2007 Geoflow added a new controller with a Touchscreen interface. It can vary dose times in each zone, monitor flow, ultraviolet, blower, and other optional inputs.

3. Pumps, Pump Tanks & Floats

Wasteflow drip fields depend on pumps to dose effluent under pressure to the field. These must be sized according to flow and pressure requirements. Look for submersible effluent pumps from a dependable source. Geoflow does not endorse a single manufacturer, but does advocate you use a pump that is readily serviced in your area. Two (duplex) pumps may be used. These will normally alternate at each signal from the control panel and are often used on commercial or large drip systems. Pump tanks should be sized according to NH Env-Wq 1000 rules and regulations. For residential systems, the dosing tank volume is suggested to be two-times the design flow. At least a 1,000 gallon pump chamber is suggested for residential applications. Geoflow controllers are set-up for 4 floats with the lowest one in the tank being the *redundant off float.* The *primary timer on/off float* is second from the bottom, followed by the *secondary timer float* third from the bottom and the *high level alarm float* on the top.

4. Filters

(See product sheet for specifications)
Geoflow systems require 120 mesh or 130 micron filtration to keep any oversized upstream contaminants from entering the dripline. Geoflow offers a full range of drip filters, with the tried and true Vortex screen filters for small commercial and residential systems, BioDisc filters with anti bacterial protection, and GeoVac suction cleaning filters for larger commercial and industrial systems.

5. Supply Manifold and Line

This carries the water from the dosing tank to the dispersal area. Rigid PVC schedule 40 is usually used. Schedule 80 is at times used to either avoid dips in the line that can collect water and freeze, or if pressure of at least 20 psi is required to pump water from the dose tank to the dripfield. To prevent water from freezing, the pipes should slope back to the pump tank, be buried below frost depth and/or be insulated. Refer to the PVC pipe sizing chart in the appendix to determine the best diameter for your application.

6. Return Manifold and Line

In order to help clean the system, the ends of the drip lines are connected together into a common return line, most often made of rigid PVC. This line will help equalize pressures in the system. Flushing should be done frequently during the installation period. Periodic flushing will help to keep the manifolds clean. Many designers use the same size return line as they do the supply line for simplicity, or some down size the return line since return flow is lower than supply. To prevent water from freezing, the pipes should slope back to the pump tank, be buried below frost depth and/or be insulated.

7. Pressure Regulator

(See product sheet for specification)
Pressure regulators fix the inlet pressure at a given rate. Under normal operating conditions, pressure in the drip lines should be 10 psi to 45 psi. With WASTEFLOW Classic it helps to know exactly what the pressure is in the dripline, so system flow can be easily calculated. With all dripline it is prudent to have a pressure regulator to avoid oversized pumps from blowing out fittings.

8. Air Vacuum Breaker

(See product sheet for specification)
Air vacuum breakers are installed at the high points, above dripline and below grade to keep soil from being sucked into the emitters due to back siphoning or backpressure. This is an absolute necessity with underground drip systems. They are also used for proper draining of the supply and return manifolds in sloping conditions. One is used on the high end of the supply manifold and one on the high point of the return manifold.
Additional air vents may be required in undulating terrain. Freezing conditions require the air vacuum breaker be protected with insulation.

9. Filter Flush Valves

(See product sheet for specifications)
Used to flush debris from the filter cleanout port back to the pretreatment or dosing tank, this can be an electronically activated solenoid valve or a manual valve. If manual, it should be opened for a full flushing at least every six months and left cracked open slightly to flush continuously. Cracking open a manual valve may be used to increase flow through the system to be within the efficient flow rate of the filter and/or pump, if necessary.

10. Field Flush Valves

(See product sheet for specifications)
Used to flush out fine particles that have passed through the filter and accumulated on the bottom of the tube at the end of each lateral, the field flush valve can be manual or electronic. If manual, it should be opened for full flushing at least every six months and left cracked open slightly to flush continuously and provide for drainage of the flush line in freezing conditions. Cracking open a manual valve can also be used to; increase the flow through the system to be within the efficient flow rate of the filter and/or pump, or to set system pressure instead of a pressure regulator.

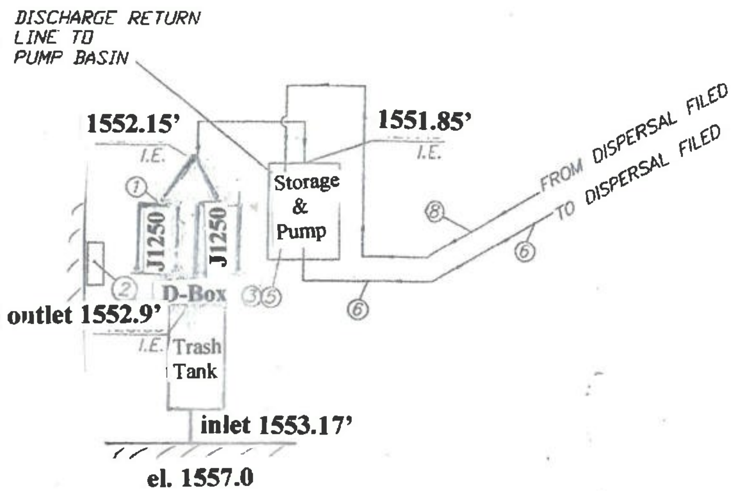
11. Zone Valves

Used to divide single dispersal fields into multiple zones, these can be hydraulically activated index valves or electrical solenoid valves. Index valves are hydraulically operated, while solenoids use electricity.

12. Wasteflow Headworks

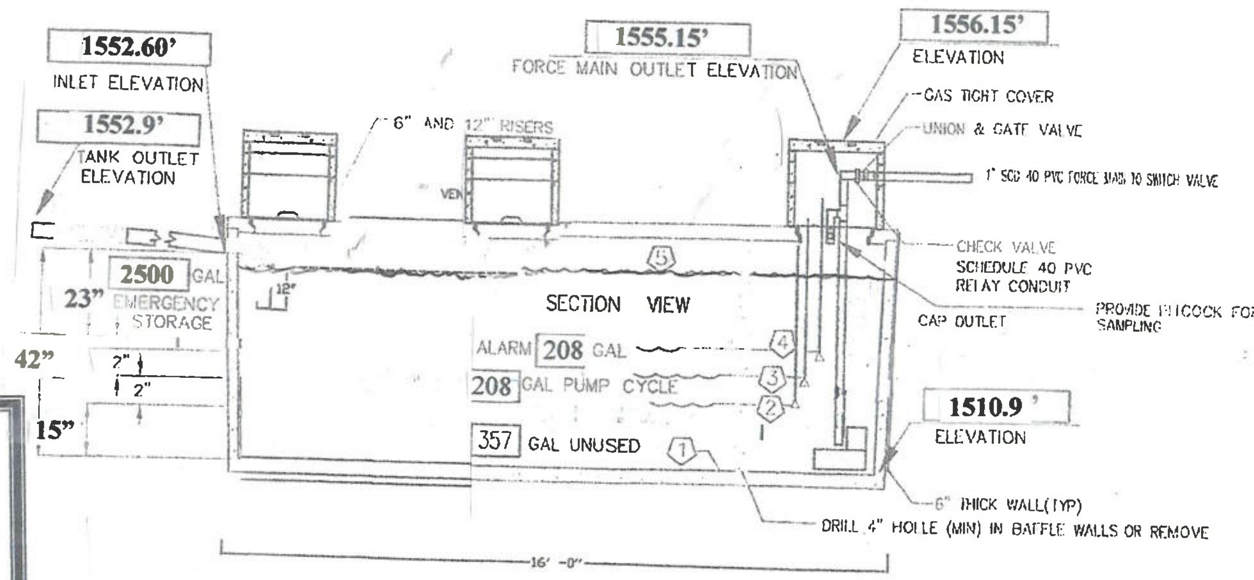
(See product sheet for specifications)
WASTEFLOW Headworks is a pre-assembled unit including the filter, valves and pressure gauge in a box or on a skid. It is installed between the pump and the field. Be sure to insulate the box in freezing climates.

Design Plat I



"24 hour Emergency Storage & Pump Chamber"

(Adapted to a *Procast* 2500 gal. Septic Tank)



			1510.9	ELEV.
① TANK BOTTOM =	0.00 INCHES	= 0.0 FT		
② PUMP OFF LEVEL =	13.6 INCHES	= 1.13 FT	1512.03	ELEV.
③ PUMP ON LEVEL =	3.14 INCHES	= 0.26 FT	1512.29	ELEV.
④ ALARM ON LEVEL =	3.14 INCHES	= 0.26 FT	1512.55	ELEV.
⑤ MAXIMUM LEVEL =	22 INCHES	= 1.83' FT	1552.60	ELEV.
TOTALS	42 INCHES	= 3.5' FT	1552.60	ELEV.

Construction Notes:

① Install two (2) *Jet Inc.* Wastewater Treatment Plants in parallel (Jet Part No. J1250) preceded by a 2500 gallon *Jensen Precast* (Model JS-2500) "pre-treatment "trash tank".

② Install free standing control pedestal w/ (Jet 196) Control Panel set for timed dosing and demand override of pump chamber.

③ Install 2500 gallon *Procast Products* (Model PC S-2500 with baffles removed or perforated with 4" holes to serve as a pump chamber and 24 hour storage.

④ Install four outlet index valves ~ K-Rain (Jet Part No. 9500049)

⑤ Install automatic flush head works w/1.5 filter in 24" poly and float tree (Jet Part No. 9550000 & 9600000, respectively).

⑥ Install 1" schedule 40 PVC supply line.

⑦ Install air vent 1" NPT w Schrader –(Jet Part No. 9200025 w/6" box – (Jet Part No. 9200026

⑧ Install 1" schedule 40 PVC return line.

Note 1: Variables used for calculating volume to determine elevation constructs are from the Tank Manufacturers Specifications of length, width and depth and the conversion of 7.48 gallons/ft.^{3}.

Note 2 Twelve cycles (208 gallons each or whatever lesser volume is within the timed dose frequency) will discharge to each of the three dispersal zones.

Best Management Practices.....Attachment "D"

The responsible party for this installation will be advised to read the "Owners Manual" and be prepared for a "follow-up" discussion. This will involve answering questions and explaining the importance of maintenance. The latter being a return on the investment in terms of avoidance of expensive repairs and the consequences of not being informed and/or committed to the recommendations of the installer.

A discussion will also be done to clearly explain how vital the preservation of the treatment environment enhances the performance of bacteria which decompose the waste water.

Attention will be directed to the following items to NOT PUT IN THE TREATMENT SYSTEM:

- Plastic, sanitary products, scouring pads, condoms, mop strings, "disposable" diapers, towels, lint, rags, etc. These reason being these items will collect in the system and require more frequent pumping.

- Paints, paint thinner, chemicals, grease, solvents and sanitizer. These kill the beneficial bacteria.

- Water softener backwash.

- Plumbing cleaners and toilet tank tablets because they too will kill off beneficial bacteria.

- Don't use concentrated detergents, that contain phosphates, or liquid fabric softeners.

- Be aware of why anti-bacterial soaps can kill off the beneficial bacteria.

- Contact the maintenance operator for a consult when antibiotics and / or chemotherapy methods are part of the waste stream. This use can seriously impact the treatment system by causing a bacterial "upset" or die-off and therefore, awareness matched with monitoring can negate this matter.

OTHER THINGS TO DO

- Know the location of the control panel and check periodically for alarm conditions.

- Keep a record of pumping, inspections, and maintenance.

- Practice water conservation to reduce the amount of water going into the Jet system.

- Know the location of the Jet system and do not construct patios, decks, and paved surfaces over the system.

- Divert roof drains and surface water away from the Jet system.

- Keep sump pump water and house footing drains away from the Jet system.

- Reduce heavy water usage periods by separating dish washing and laundry from shower time.

- Use dryer sheets in the dryer in place of liquid fabric softeners in the wash cycle.

- Use detergents without phosphates (i.e., seventh Generation Free & Clear, Method 3x Concentrate, Arm & Hammer, Era, Oxydol, SA-8).

Other Best Management Practices

The owner will be advised to contact the lead regulatory agency in the case of any conveyance of the property to a new owner or party of interest with disclosure of all matters related to this disposal system and operational permit conditions.

Other advisory elements may be added from time to time as site specific issues might occur.

Design Plat II

Reference Plat of Project Site

(See Design Plat III for Details)

Wastewater Disposal

Mountain View Community Church

[APN 124-351-14-00]

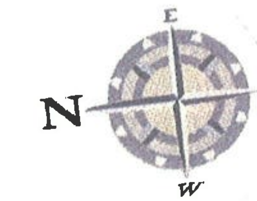
Special Notes

1. The existing leach field must be managed for replacement by the dispersal system so that when the new dispersal system is installed, the existing septic tank and leach field can be decommissioned to the satisfaction of all regulatory agencies.

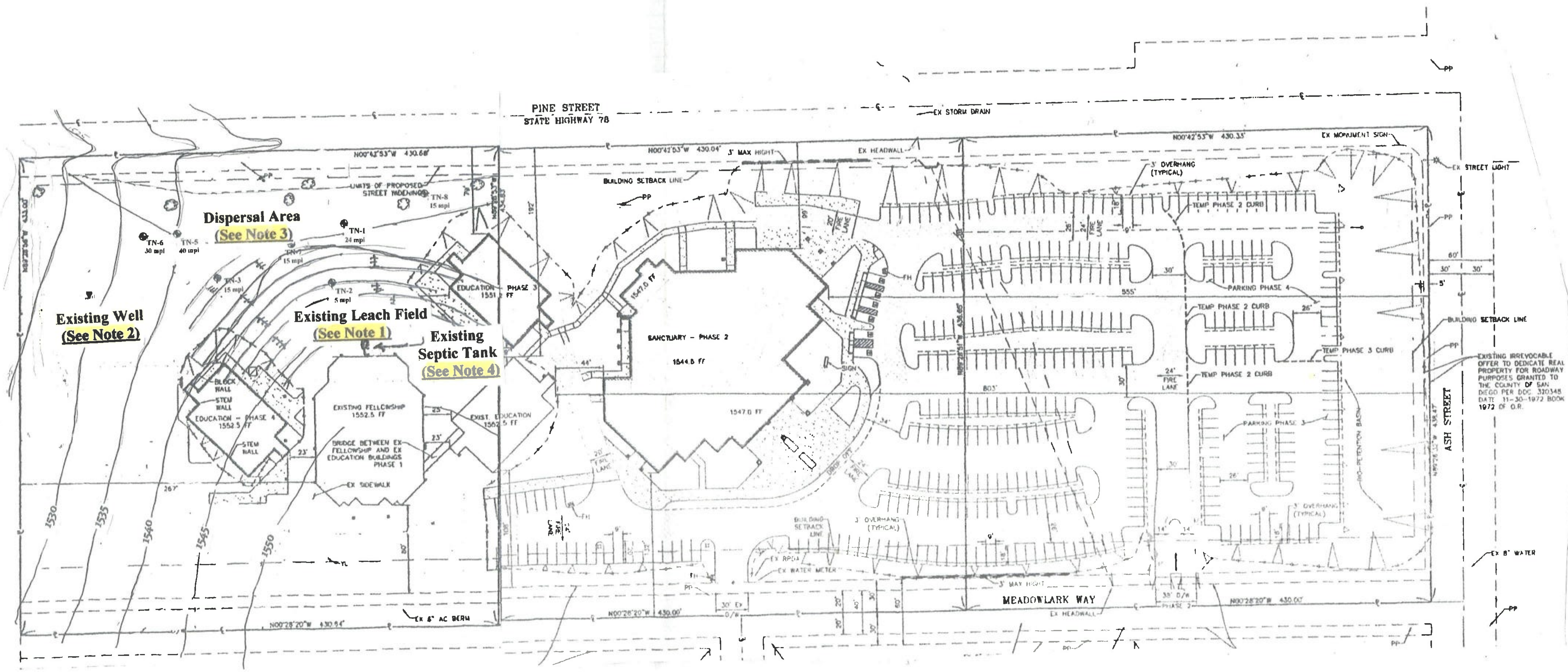
2. The existing well (Permit W06897) will be utilized for onsite landscape irrigation and be separated from the domestic water by an approved backflow device such as an "RP" ("Reduced Pressure Principle Device).

3. The dispersal system is 200% oversized in accordance with County Regulation. This can be argued for a reduction to 150% or less if subsequent flow information can justify this change.

4. The existing septic tank can be either decommissioned or used as a pretreatment "trash tank" at the time of the dispersal system installation if plumbing from the new construction can be accommodate gravity flow with an approved plumbing plan check.



Scale: 1 inch = 100 feet



Wastewater Disposal

Mountain View Community Church

Pcl. 4 of PM 10026

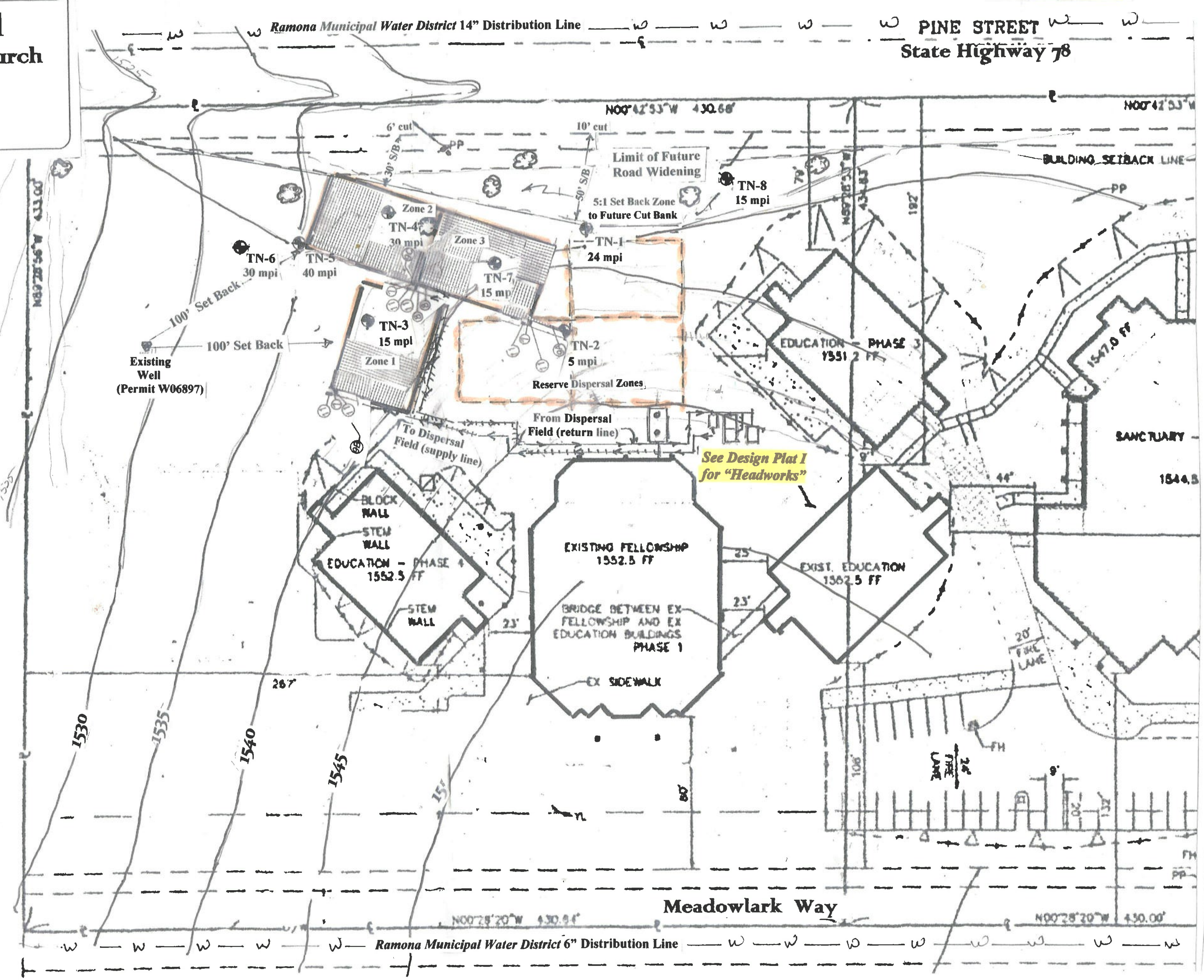
[APN 124-351-14-00]

Scale: 1 inch = 50 feet

N

Legend

- Head Works
- Supply & Return Lines
- Dispersal Zones
- Perc Test (08/08/2014)
- Cut/Fill
- Domestic Water
- Utilities
- Drainage
- Well



Dispersal Field Constructs

(4) Install three outlet index valves ~ K-Rain (Jet Part No. 9500049)

(6) Install 1" schedule 40 PVC supply line.

(7) Install air vent 1" NPT w Schrader –(Jet Part No. 9200025 w/6" box –(Jet Part No 9200026)

(8) Install 1" schedule 40 PVC return line.

9a Install Dripfield "A" -25(qty).) ~ 1250 linear feet *Wasteflow* PC-1/2 GPH *Geoflow* Pipe w/emitters at 2' OC. 6" burial depth

9b Install Dripfield "B" -25 (qty).) ~ 1250 linear feet *Wasteflow* PC-1/2 GPH *Geoflow* Pipe w /emitters at 2' OC. 6" burial depth

(11) Install 1" true union check valve –(Jet Part No. 9200032).